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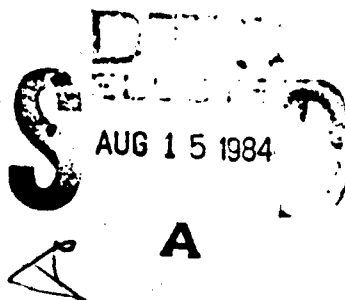
AD-A144 416

Software Acquisition Documentation Requirements for Mode Select Beacon System (Mode S) Sensor

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January 1984



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Acquisition For



A-1

Technical Report Documentation Page

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16. Abstract <p>These guidelines specify the content and extent of documentation requirements for software/firmware developed for the Mode S System. Document types related to development phases are specified and content requirements for eleven document types are provided.</p> <p>Parts 1 through 10 specify requirements for the development of documentation for each Mode S computer program configuration item (CPCI) throughout the development, test, acceptance, and operational phases of the Mode S Program. Part eleven specifies requirements for defining the management methods employed in support of CPCI development. The eleven document types are:</p> <p>Mode S Functional Requirements Document; Mode S Software Top Level Design Document; Mode S Software Detailed Design Document; Software Test Plan; Software Test Procedures; Software Test Report; Version Description Document; Software Users Manual; Software Maintenance Manual; Diagnostics Manual; Software Development Plan</p> <p>The requirements specified for documenting software/firmware requirements constitute a documentation methodology that requires the hierarchical traceability of all Mode S System Specification software/firmware from the FAA-E-2716 Specification to the lowest level of decomposition.</p>					
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METRIC CONVERSION FACTORS

Approximate Conversions to Metric Measures

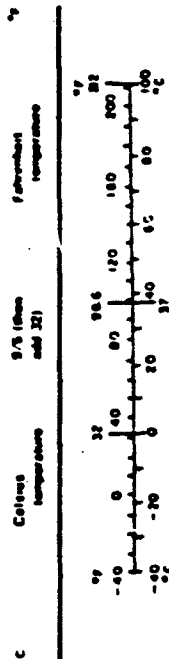
Symbol	When You Know	Multiply by	To Find	Symbol
LENGTH				
m	meters	1.09	yards	y
cm	centimeters	39	inches	in
mm	millimeters	25	inches	in
km	kilometers	0.62	miles	mi
AREA				
m ²	square meters	1.19	square yards	sq yd
cm ²	square centimeters	1.55	square inches	sq in
mm ²	square millimeters	3.86	square inches	sq in
ha	hectares	2.47	acres	ac
MASS (weight)				
kg	kilograms	2.2	pounds	lb
g	grams	35	ounces	oz
mg	milligrams	1.58	ounces	oz
tonne	metric tons (1,000 kg)	2,205	tons	ton
VOLUME				
m ³	cubic meters	35.3	cubic feet	cu ft
l	liters	1.06	quarts	qt
ml	milliliters	0.26	fluid ounces	fl oz
cc	cubic centimeters	0.034	cubic inches	cu in
dm ³	cubic decimeters	3.38	gallons	gal
cm ³	cubic centimeters	0.00026	cubic feet	cu ft
mm ³	cubic millimeters	3.54e-5	cubic inches	cu in
TEMPERATURE (exact)				
°C	Celsius temperature	9/5 after subtracting 32	Fahrenheit temperature	°F

1 m = 1.09361 yd; 1 cm = 0.3937 in; 1 mm = 0.03937 in; 1 km = 0.621371 mi; 1 ha = 2.47105 ac; 1 tonne = 2,204.62 lb; 1 m³ = 35.3147 cu ft; 1 l = 1.05669 qt; 1 ml = 0.033814 fl oz; 1 cc = 0.0610237 cu in; 1 dm³ = 61.0237 cu in; 1 cm³ = 0.0610237 cu in; 1 mm³ = 6.10237e-5 cu in

60 mph = 52.1 knots (nautical miles per hour)
60 mph = 88 ft/sec
1 g = 32.2 ft/sec²

Approximate Conversions from Metric Measures

When You Know	Multiply by	To Find	Symbol
LENGTH			
yards	0.91	meters	m
inches	2.54	centimeters	cm
feet	30.5	centimeters	cm
miles	1.61	kilometers	km
acres	0.40	hectares	ha
AREA			
square yards	0.84	square meters	m ²
square feet	0.093	square meters	m ²
square inches	6.45	square centimeters	cm ²
acres	4,047	square meters	m ²
MASS (weight)			
pounds	0.45	kilograms	kg
ounces	28.35	grams	g
tons	907	metric tons (1,000 kg)	tonne
VOLUME			
fluid ounces	29.6	milliliters	ml
quarts	0.95	liters	l
gallons	3.78	liters	l
cubic feet	28.3	cubic meters	m ³
cubic inches	16.4	cubic centimeters	cm ³
TEMPERATURE (exact)			
°F	5/9 after subtracting 32	Celsius temperature	°C



1 mph = .87 knots
1 knot = 1.15 mph

INTRODUCTION

The documentation requirements specified herein are based on the documentation concepts contained in Federal Information Processing Standards Publication 38 and are tailored to the unique requirements of the MODE S program.

Parts 1 through 10 specify requirements for the development of documentation for each MODE S computer program configuration item (CPCI) that provide traceability of all functional, performance, interface, and special software requirements contained in the MODE S System Specification, FAA-E-2716, throughout the development, test, acceptance, and operational phases of the MODE S program. Part 11 specifies requirements for defining the management techniques, procedures and controls the contractor will use in support of CPCI development. The requirements specified for documenting software design requirements constitute a documentation methodology that requires the hierarchical traceability of all MODE S System Specification software requirements successively downward to their lowest level of decomposition, and the reverse (i.e., successively upward from their lowest level of decomposition to the MODE S System Specification requirements).

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APPLICABLE DOCUMENTS

The following documents of the exact issue shown form a part of this document (DOT/FAA/PM-83/37) to the extent specified herein. In the event of conflict between the referenced documents and the contents of this document, the contents of this document shall be considered a superceding requirement. However, this document shall not negate requirements of the MODE Select Beacon System (MODE S) Sensor Specification.

FAA Specification.

FAA-E-2716 & AMEND.-2
SPECIFICATION CHANGE-3
December 22, 1983

Department of Transportation,
Federal Aviation Administration
Specification, MODE Select
Beacon System (MODE S) Sensor

Military Standard

MIL-STD-881A

Work Breakdown Structures for
Defense Material Items

Other documents.

ANSI X3.5-1970

Flowchart Symbols and Their
Usage in Information Processing

ANSI Y1.1-1972

Abbreviations

PART 1

MODE S Functional Requirements Document

1. PURPOSE

The purpose of the functional requirements document (FRD) is to establish the initial MODE S software/firmware allocated baseline. The FRD shall document the results of the requirements analysis performed by the contractor relative to the allocation of the overall software/firmware requirements specified in the MODE S System Specification, FAA-E-2716, inclusive of any derived requirements to the system software/firmware architecture and respective computer program configuration items (CPCIs). The FRD shall contain a description of the software/firmware functional requirements, their corresponding performance requirements and the verification requirements necessary to assure their respective attainment.

The FRD shall provide a traceability matrix cross referencing each CPCI and its functional and performance requirements to applicable source paragraphs of the MODE S System Specification, from which the requirements are allocated.

2. INSTRUCTIONS FOR PREPARATION OF THE MODE S FUNCTIONAL REQUIREMENTS DOCUMENT

Contents of the FRD shall be prepared in accordance with Appendix I and arranged in accordance with the instructions, format and paragraph headings described in Figure 1. Deviations from the requirements stated herein require approval of the FAA Contracting Officer prior to implementation.

3. DETAILED INSTRUCTIONS FOR PREPARATION OF THE MODE S FUNCTIONAL REQUIREMENTS DOCUMENT

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Figure 1. MODE S Functional Requirements Document

SECTION 1. SCOPE

Section 1 shall contain a summary of the purpose of the FRD and a brief description of each of the major sections covered by the document.

SECTION 2. DOCUMENTS

Section 2 shall be in accordance with the following format:

2.1 Applicable documents.- The following documents of the exact issue shown form a part of the FRD to the extent specified herein. In the event of conflict between the referenced documents and the contents of the FRD, the contents of the FRD shall be considered a superceding requirement. However, the FRD shall not negate requirements of the MODE S System Specification.

Specifications:

Federal
Military
Other Government Activity
Commercial

Standards:

Federal
Military
Other Government Activity
Commercial

Other Publications: (Identify the source within the contractor's organization from whom the documents can be obtained.)

2.2 References.- Reference to a document within the body of the FRD shall be to its basic document number and specifically identified requirement(s) or other definitive designation, and it is applicable only to the extent invoked. If a document referenced in Section 2 references a second document, the applicability of the second document (or subsequent documents) is limited to the specific portions referenced in the first (or referencing) document.

Figure 1. MODE S Functional Requirements Document

SECTION 3. REQUIREMENTS

This section shall specify the software/firmware requirements allocated from the MODE S System Specification, FAA-E-2716. It shall also include any derived requirements and requirements based on architectural limitations and operational considerations. Each requirement shall be specified relative to function, performance, design constraints, attributes and external interfaces. Requirements shall be specified in a manner that is complete, consistent, clear, concise and subject to a single interpretation, and that provides for objective verification of attainment by inspection, demonstration, analysis or test. Each requirement shall be allocated to a specific CPCI and a traceability matrix shall be included that provides a cross reference between the requirements allocated to each CPCI and their respective MODE S System Specification source paragraph.

3.1 Allocated CPCI requirements.- Specify in the sub-paragraphs below the software/firmware requirements allocated to each CPCI. Each CPCI shall be defined separately in accordance with the following sub-paragraph structure and consistent with the requirements of the previous paragraph. Paragraph 3.1.N and its sub-paragraphs shall be repeated for each CPCI.

3.1.N CPCI summary.- This paragraph shall identify the name/title and number comprising the CPCI identification, and shall contain a summary of the purpose of the CPCI and a brief description of the CPCI by major function(s).

3.1.N.1 Function N.- The basic paragraph for each function shall specify the function to be performed and its purpose in the MODE S system. The operating modes, relationship to other functional requirements, required responses to error, out of range and failure conditions shall be specified. Any data transformation formulas or algorithms required by the MODE S System Specification shall also be specified. Paragraph 3.1.N.1 and the following sub-paragraphs shall be repeated for each function.

3.1.N.1.1 Inputs.- Specify the data input requirements for the function in terms of data element characteristics including source, quantity, data representation, accuracy and precision, valid ranges, frequency, and the tolerances and disposition of illegal values. Identify interface control specifications and control documents as applicable.

3.1.N.1.2 Outputs.- Specify the data output requirements for the function in terms of data element characteristics including destinations, quantity, data representation, accuracy and precision, valid ranges, frequency, and the tolerances and disposition of illegal values. Identify interface control specifications and control documents as applicable.

Figure 1. MODE S Functional Requirements Document

3.1.N.2 Performance.- Specify performance budget requirements in quantitative terms for all operational, error and failure modes including tolerances where applicable. Performance parameters associated with processing requirements shall be stated in terms of system availability, response time and recovery time. Transaction frequency and capacity requirements shall be specified for normal and peak workload conditions. The most limiting performance constraint shall be stated for each requirement.

3.1.N.3 Design constraints.- Specify the design constraints imposed by trade studies, architectural considerations, applicable standards, and hardware limitations.

3.1.N.4 Attributes.- Specify the requirements relative to data monitoring and recording, maintainability, portability, expansion and those imposed as a result of the remote maintenance concept.

3.1.N.5 External interface requirements.- Specify all interface requirements in terms of format, characteristics, protocols, timing, availability, data, and physical and electrical interfaces. Include as applicable all user hardware, software and communication requirements.

3.1.N.6 Site adaptation requirements.- Specify the adaptation requirements for each site including data or initialization sequences and features that require modification to adapt the CPCI to a particular installation.

SECTION 4. VERIFICATION REQUIREMENTS

This section shall specify the acceptance criteria and method of verification for each functional and performance requirement specified in Section 3. A system level performance test concept which validates the system performance including operational scenarios and workload requirements necessary to provide the data for test at the system level shall also be specified. Scenarios shall be selected to test the system under normal conditions, under conditions of maximum expected loads, and error and failure conditions.

SECTION 5. TRACEABILITY MATRIX

This section shall identify each functional and related performance requirement by its source paragraph number in the MODE S system specification cross referenced to the CPCI to which it is allocated. Requirements specified in more than one paragraph shall be so stated. Each requirement shall be uniquely identified herein and the identification shall be used in all Software Top Level Design Documents and Software Detail Design Documents prepared for each CPCI.

Figure 1. MODE S Functional Requirements Document

SECTION 6. NOTES

This section of the FRD is not contractually binding, and should not contain contractual requirements. It may include information of particular importance to the MODE S Program Office in using the FRD as a contractual instrument or administrative or background information. It shall not include requirements which constrain design, development, or qualification of the CPCIs. The text shall be preceded with the statement "Administrative Information Only - Not Contractually Binding". Background information or rationale which will be of assistance in understanding the FRD itself or the allocation of requirements to the CPCIs it specifies, may be included. The FAA Contracting Officer will specify material which is mandatory for inclusion in Section 6.

SECTION 7, 8, & 9. Not used.

SECTION 10. APPENDIX

If used, this section shall contain only those requirements which are a part of the FRD but are bound separately for convenience, e.g., charts, multi-site adaptation requirements, classified data, etc. Each appendix shall be referenced in the main body of the FRD where the data would normally have been specified. If the need for more than one appendix arises, they shall be numbered in increments of 10 (i.e., 10, 20, 30, 40, etc.).

Figure 1. MODE S Functional Requirements Document

PART 2

MODE S Software Top Level Design Document

1. PURPOSE

The purpose of the software top level design document(s) (STLDD) is to establish the final MODE S software/firmware allocated baseline for each CPCI. The STLDD shall specify the detailed requirements peculiar to the design, development, functional performance, test and qualification of each CPCI as allocated in the FPD from the MODE S System Specification.

2. INSTRUCTIONS FOR PREPARATION OF A SOFTWARE TOP LEVEL DESIGN DOCUMENT

Contents of the STLDD shall be prepared in accordance with Appendix I and arranged in accordance with the instructions, format and paragraph headings described in Figure 2. Deviations from the requirements stated herein require approval of the FAA Contracting Officer prior to implementation.

3. DETAILED INSTRUCTIONS FOR PREPARATION OF A MODE S SOFTWARE TOP LEVEL DESIGN DOCUMENT.

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Figure 2. MODE S Software Top Level Design Document

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Figure 2. MODE S Software Top Level Design Document

SECTION 1. SCOPE

The content of Section 1 of the STLDD shall be as follows:

1.1 Identification.- This paragraph of the STLDD shall contain the approved identification for the CPCI as specified by the approved PRD and shall begin with the following opening phrase: "This document establishes the performance, development, test and qualification requirements of a CPCI identified as (insert approved identification including CPCI number)".

1.2 Functional summary.- This paragraph shall contain a summary of the purpose of the CPCI and a brief description of the overall CPCI by major function(s). Words similar to the following shall be used: "This CPCI is used to (provide) (accomplish)..."

SECTION 2. DOCUMENTS

Section 2 shall be in accordance with the following format:

2.1 Applicable documents.- The following documents of the exact issue shown form a part of the STLDD to the extent specified herein. In the event of conflict between the referenced documents and the contents of the STLDD, the contents of the STLDD shall be considered a superceding requirement. However, the STLDD shall not negate requirements of the MODE S System Specification or the PRD.

Specifications:

Federal
Military
Other Government Activity
Commercial

Standards:

Federal
Military
Other Government Activity
Commercial

Other Publications: (Identify the source within the contractor's organization from whom the documents can be obtained.)

2.2 References.- Within the body of the STLDD, reference to a document shall be to its basic document number and specifically identified requirement(s) or

other definitive designation. If a document referenced in Section 2 references a second document, the applicability of the second document (or subsequent documents) is limited to the specific portions referenced in the first (or referencing) document. A document listed in Section 2 is applicable only to the extent it is invoked within the body of the STLDD.

SECTION 3. REQUIREMENTS

This section shall contain performance requirements for the CPCI. The introductory paragraph shall include a general description of the CPCI and its functions within the system/equipment to which it applies. It shall further include the functional requirements for the CPCI and establish those requirements which will be verified during test. This section shall also define the CPCI interfaces and specify standards necessary to assure compatibility of the CPCI with other CPCIs and equipment (CIs). Performance requirements to be included herein shall be identical with the requirements established by the FRD. Requirements specified herein shall be directly referenced by paragraph number to the requirements contained in the FRD, and shall be specified quantitatively and to the level of detail necessary to establish limits for design.

3.1 Software definition.- Specify in the sub-paragraphs below the functional relationship of the CPCI to other CIs and CPCIs, general and/or descriptive material may be included.

3.1.1 System capacities.- Specify the capacity requirements for the CPCI including storage and timing values. Items such as capacity for total number of simultaneous tracks and number and types of inputs processed shall be described. Computer storage capacities and internal timing rates including computer processor execution rates shall be included.

3.1.2 Interface requirements.- Specify, either directly or by reference, requirements imposed on the design of the CPCI because of its relationship to other CIs/CPCIs. Include the detailed interface definitions contained in the FRD. General and/or descriptive material may be included. Quantitative requirements shall be included in the sub-paragraphs below. If the compiler/assembler is another or a part of another CPCI the computer program language(s) to be employed shall be specified as one of the interfaces in 3.1.2.2. If the compiler/assembler is to be constructed as part of the development of this CPCI, the language characteristics shall be defined under 3.2.

3.1.2.1 Interface block diagram.- The relationship of the CPCI to other CIs/CPCIs with which it must interface shall be graphically portrayed. Incorporate a functional block diagram, or equivalent representation of the interface requirements of the CPCI. The graphic portrayal of the CPCI shall be accomplished to the level of detail necessary to identify all functional interfaces between the CPCI and other CIs/CPCIs. These interfaces shall be labeled to facilitate cross-reference to sub-paragraphs of 3.1.2.2.

3.1.2.2 Detailed interface definition.- Specify in sub-paragraphs, as appropriate, the functional relationship of the CPCI to interfacing equipment (e.g., operator console equipment, display mechanisms, junction and distribution boxes, terminal boards, etc.), personnel, and CPCIs. This information shall be given in quantitative terms with tolerances where applicable, to the level of detail necessary to permit design of the CPCI. Functional interfaces shall specify the input/output requirements of the CPCI in terms of data rate and message format.

3.2 Detailed functional requirements.- List all the functions and, in sub-paragraphs below, specify the functional requirements of the CPCI. A sub-paragraph shall be included for each function, such as sequencing control, displays, error detection and recovery, input and output control, real time diagnostics, and operational data recording. Requirements shall be stated in quantitative terms, with tolerances where applicable. General and descriptive material may be included in this paragraph. Appropriate functional flow diagrams (or equivalent representation) shall be incorporated to the level of detail necessary to illustrate the functional operation of the CPCI, the relationships between CPCI functions, and the relationships between the functions and other identified system/equipment functions. The diagram(s) need not necessarily reflect the ultimate allocation of functions to computer program components (CPCs). The diagram(s) is not intended to reflect or restrict the CPCI detail design nor to duplicate what is required in paragraph 3.2 of the Software Detailed Design Document, but is intended to facilitate the understanding of the functional relationships of the system. The diagram(s) shall show the major processes and decisions needed for each functional requirement of the CPCI. The diagram(s) shall be organized in terms of requirements and need not necessarily reflect the final software architecture.

Figure 2. MODE S Software Top Level Design Document

Requirements for each separately identified CPCI function shall be described in subsequent paragraphs as appropriate. The descriptions of these CPCI functional requirements shall include the relative sequencing, periodicities, options, and other important relationships of each as appropriate. Paragraph 3.2.N and its sub-paragraphs shall be repeated for each function.

3.2.N Function n.- The basic paragraph for each function shall begin with descriptive and introductory material which defines the function and its relationship to other functions. The following three sub-paragraphs shall specify the quantitative requirements concerning the function.

3.2.N.1 Inputs.- Specify either directly or by reference to another part of the STLDD, the source(s) and type(s) of input information associated with a function of the CPCI. This shall include a description of the information, its source(s) and in quantitative terms, units of measure, limits and/or ranges of units of measures, accuracy/precision requirements, and frequency of input information arrival. A tabular presentation may be used where appropriate.

3.2.N.2 Processing.- Provide a textual, mathematical, and algorithmic (as applicable) description of each processing requirement of each function including each sub-function comprising the function. Describe the purpose of the mathematical operation(s) and provide a textual description of each mathematical operation specified including a definition of input/output parameters. The narrative shall identify accuracies required, sequence and timing of events, and relevant restrictions or limitations. Derived equations shall be shown with appropriate mathematical and control symbols adequately defined. Algorithms to implement the equations shall not be included herein, but shall be included in the Software Detailed Design Document.

3.2.N.3 Outputs.- Specify either directly or by reference to another part of the STLDD, the destination(s) and type(s) of output information associated with a function of the CPCI as a result of the processing described in 3.2.N.2. This shall include a description of the information, its destination(s), and in quantitative terms, units of measure, accuracy/precision requirements, and frequency of output information where applicable. A tabular presentation may be used where appropriate.

Figure 2. MODE S Software Top Level Design Document

3.2.N.4 Control.- Specify directly or by reference to another part of this document all of the conditions under which this function will be enabled, the method(s) by which it will be enabled, the exit conditions, and the method(s) of relinquishing control.

3.3 Special requirements.- Specify in appropriate sub-paragraphs, requirements which affect the design of the CPCI and are distinguishable from the requirements of 3.2. These requirements result from general considerations of CPCI useability and may include, but are not limited to the following. The sub-paragraph organization of 3.3 which follows is not a mandatory requirement as long as the overall content requirements of 3.3 are observed.

3.3.1 Programming method(s).- Requirements for programming standards or methods, such as structured programming, shall be stated to assure compatibility among computer program components (CPCs), sub-programs or groups of sub-programs.

3.3.2 Program organization.- Requirements for program organization, such as overall program segmentation shall be stated. In addition, for CPCIs which contain or process classified information, special attention shall be given to the requirements for protecting classified information.

3.3.3 Modification consideration.- Requirements shall be stated regarding program design resulting from consideration of modifications to the CPCI during operation (e.g., on-site modification requirements and the permissible amount of operational degradation allowed during installation or modification may be specified).

3.3.4 Special features.- Special feature requirements to facilitate the testing of the CPCI shall be stated. For example, special procedures for the design of CPC interfaces and requirements for intermediate printouts should be specified.

3.3.5 Expandability.- Requirements for expandability (growth potential) to facilitate modifications and additions to the CPCI including memory and timing considerations shall be stated.

3.3.6 Special timing.- Special timing on priority requirements shall be stated.

Figure 2. MODE S Software Top Level Design Document

3.4 Human performance.- Specify human performance/human engineering requirements for the CPCI (e.g., minimum time for human decision making, maximum time for program response, maximum display densities of information, format and clarity requirements for displays, etc.). Cite the appropriate paragraph(s) of the FRD which establish human performance/human engineering requirements applicable to this CPCI.

3.5 Data base requirements.- Data base requirements which affect the design of the CPCI shall be defined fully in the sub-paragraphs below, including precise definitions of all specified data elements together with units of measure, ranges of values, and accuracies/precision where applicable. The data base encompasses all data to be coded and inserted into the system prior to operation of the CPCI; and all data elements, structures, files, tables, and items accessed by the CPCI during operation both internal and external to computer memory. Data definitions shall be organized by the system data base structure into categories which are meaningful and appropriate to the given CPCI, e.g., general equivalent, variable parameters, or others. Sub-paragraphs shall specify the requirements concerning source and type of input, destination and type of output, and internal tables and parameters when applicable. Material contained in 3.2 that is applicable to this section shall be specified by reference to the lowest sub-paragraph level that applies.

3.5.1 Sources and types of input.- Specify the sources and types of input information. This shall include a description of the information, including its sources, units of measure, and in quantitative terms, limits and/or ranges, accuracy requirements, precision requirements, and frequency of arrival, where applicable.

3.5.2 Destinations and types of outputs.- Specify the destinations and types of output information as a result of the processing described in 3.2. This shall include a description of the information, its destinations and units of measure, and in quantitative terms, accuracy requirements, precision requirements, and frequency of output, where applicable.

3.5.3 Internal tables and parameters.- Specify the requirements for all major internal processing data areas and parameters which affect the design.

3.6 Adaptation requirements.- Describe site or mission related data and software features which must be properly modified or reinitialized to adapt the CPCI for use at particular installations or for alternative missions or modes of operation. Define all requirements for CPCI initialization and insertion of data specific to each installation, and/or mode.

Figure 2. MODE S Software Top Level Design Document

SECTION 4. QUALITY ASSURANCE PROVISIONS

This section shall include references to all functional and performance requirements of Section 3 and the delivery requirements of Section 5 and specify the test requirements and specific verification of those requirements. This section shall not incorporate, either directly or by reference, detail test planning documentation or procedural instructions. Requirements specified herein shall be the basis for preparation and validation of such documents. This section shall:

- a. Designate in sub-paragraphs as appropriate, specific verification requirement(s) for each performance and functional requirement defined in Section 3. The methods of verification of the CPCI may include review of analytical data (analysis), demonstration(s) and tests (witnessing tests and review of qualitative and quantitative test data resulting from formal procedures, controlled environment and instrumentation)
- b. Specify requirement(s) for verification to the level of detail necessary to establish the scope and accuracy of the verification method.
- c. Clearly identify each verification requirement with the applicable functional/performance/delivery requirements in Sections 3 and 5.

NOTE: Requirements for verification included in the MODE S System Specification which are directly related to requirements specified herein shall be incorporated by reference, to avoid redundant establishment of requirements.

4.1 Computer program test and evaluation.- This paragraph shall specify the requirements for computer program test and evaluation which satisfies one or both of the criteria listed below. These requirements include test formulas, algorithms, techniques and acceptable tolerance limits as applicable. The specific type and a description of method shall be included.

- a. The test results are intended to be the only source of data to verify specific requirements of Section 3.
- b. The tests must be accomplished as part of an integrated test program involving other system/equipment/computer programs (e.g., verification of requirements in 3.1.1).

Figure 2. MODE S Software Top Level Design Document

4.2 Preliminary qualification tests.- This paragraph shall specify only those preliminary qualification test requirements which are oriented toward verifying proper performance of portions of the CPCI prior to integrated testing of the entire CPCI. These requirements include test formulas, algorithms, techniques and acceptable tolerance limits, as applicable. Preliminary qualification test requirements specified herein shall reference performance requirements of Section 3.

4.3 Formal qualification tests.- This paragraph shall specify requirements for formal qualification tests of the integrated CPCI to verify that the requirements established in Section 3 have been satisfied. These requirements include test formulas, algorithms, techniques and acceptable tolerance limits, as applicable. This paragraph shall, in sub-paragraphs as appropriate, specify the requirements and method of verification for each requirement specified in Section 3 which has not been satisfied by verification tests specified in 4.2 and 4.3, or is peculiar to system testing and will be specified in 4.5. Verification of the requirements may be accomplished by analysis, inspection, demonstration, test, review of test data, or combinations of these. This paragraph shall contain a sub-paragraph for each of the principal methods of verification, and shall specify therein the requirements of Section 3 to be verified by the method.

4.4 System test program.- This paragraph shall identify requirements specified in Section 3 which cannot be verified until system testing or equivalent and which therefore must be listed as a system test requirement.

4.5 Verification cross-reference matrix.- This paragraph shall include a Verification Cross-Reference Matrix identifying each Section 3 requirement with the Section 4 paragraph/sub-paragraph where the qualification requirement(s) is specified.

SECTION 5. PREPARATION FOR DELIVERY

This paragraph shall be used to describe special handling requirements such as packaging for delivery which may require special labels, etc. This paragraph shall also specify the media of delivery, such as magnetic tape, firmware and disks. Also included shall be the general or specific characteristics of the media as required for qualification testing and verification. If special or unique packaging is required to avert possible compromise of CPCI performance, then packaging requirements shall be included.

Figure 2. MODE S Software Top Level Design Document

SECTION 6. NOTES

This section of the STLDD is not contractually binding, and should not contain contractual requirements. It may include information of particular importance to the MODE S Program Office in using the STLDD as a contractual instrument or administrative or background information (e.g., ordering instructions for technical data pertaining to the computer program, or specific information related to the use of the program in future assembly and integration + sting). It shall not include requirements which constrain design, development, or qualification of the CPCI. The text shall be preceded with the statement "Administrative Information Only - Not Contractually Binding". This section may reflect the technical manuals which can be singularly and peculiarly identified with the CPCI, and which are necessary to its operation and maintenance. Background information or rationale which will be of assistance in understanding the STLDD itself or using the CPCI it specifies, may be included. The MODE S Program Office will specify material which is mandatory for inclusion in Section 6.

SECTION 7, 8, & 9 Not used.

SECTION 10. APPENDIX

If used, this section of the STLDD shall contain only those requirements which are contractually a part of the STLDD but are bound separately for convenience, e.g., charts, multi-site adaptation requirements, classified data, etc. Each appendix shall be referenced in the main body of the STLDD where the data would normally have been specified. If the need for more than one appendix arises, they shall be numbered in increments of 10 (i.e., 10, 20, 30, 40, etc.).

Figure 2. MODE S Software Top Level Design Document

PART 3

MODE S Software Detailed Design Document

1. PURPOSE

The purpose of the Software Detailed Design Document (SDDD) is to specify exact design and configuration information peculiar to each CPCI. It establishes programming terminology, techniques, and implementing media and completely identifies the CPCI as designed and as built. The "as designed" SDDD shall be delivered prior to critical design review (prior to coding), and on Government approval of the CDR minutes it establishes the CPCI developmental baseline; the "as built" SDDD is identical to the "as designed" SDDD except that it will reflect those changes deemed necessary and incorporated in the coding process, and shall be delivered prior to physical configuration audit and on Government authentication it establishes the CPCI product baseline.

2. INSTRUCTIONS FOR PREPARATION OF A SOFTWARE DETAILED DESIGN DOCUMENT

Contents of the SDDD shall be prepared in accordance with Appendix I and arranged in accordance with the instructions, format and paragraph headings described in Figure 3. Deviations from the requirements stated herein require approval of the FAA Contracting Officer prior to implementation.

3. DETAILED INSTRUCTIONS FOR PREPARATION OF A MODE S SOFTWARE DETAILED DESIGN DOCUMENT

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SECTION 1. SCOPE

The content of Section 1 of the SDDD shall be as follows:

1.1 Identification.- This paragraph shall contain the approved identification of the CPCI established by the approved FRD and shall begin with the following opening phrase: "This document establishes the requirements for complete identification of (insert approved identification including CPCI number)".

1.2 Functional summary.- This paragraph shall contain a summary of the purpose of the CPCI and a brief description of the overall CPCI by major function(s). Words similar to the following shall be used: "this CPCI is used to (provide) (accomplish)..."

SECTION 2. DOCUMENTS

Section 2 shall be in accordance with the following format:

2.1 Applicable documents.- The following documents of the exact issue shown form a part of the SDDD to the extent specified herein. In the event of conflict between the referenced documents and the contents of the SDDD, the contents of the SDDD shall be considered a superceding requirement. However, the SDDD shall not negate requirements of the MODE S Software Top Level Design Document, FRD or Mode S System Specification.

Specifications:

Federal
Military
Other Government Activity
Commercial

Standards:

Federal
Military
Other Government Activity
Commercial

Other Publications: (Identify the source within the contractor's organization from whom the documents can be obtained.)

Figure 3. MODE S Software Detailed Design Document

2.2 References.- Within the body of the SDDD, reference to a document shall be to its basic document number and the specifically identified requirement(s) or other definitive designation. If a document in Section 2 references a second document, the applicability of the second document (or subsequent documents) is limited to the specific portions referenced in the first (or referencing) document. A document listed in this section is applicable only to the extent it is invoked within the body of the SDDD.

SECTION 3. REQUIREMENTS

This section shall specify the "as designed" or "as built" configuration of the CPCI. It shall contain a description of the CPCI, including structure, functions, language(s) and data base, and the individual computer program components (CPCs). The rules established for assigning symbolic names and register usage conventions to components within the CPCI shall be delineated. General and descriptive material may be included.

3.1 CPCI structural description.- Describe the overall structure of the CPCI. Include a matrix depicting the allocation of functions as defined in the STLDD to the computer program components (CPCs) that comprise the CPCI. If the CPCs are grouped into functional entities (packages), this grouping shall be delineated. A graphic portrayal (CPCI/CPC Tree) shall be included to establish the general relationship of the CPCs to a CPCI and to each other.

3.2 Functional flow diagrams/program design language (PDL) descriptions.- This paragraph and subsequent sub-paragraphs shall show the general system flow of both data and control within the CPCI. PDL descriptions, functional flow diagrams, or their equivalent shall be included to depict entity relationships, overall information flow and dynamics within the CPCI, and shall identify the input, processing and outputs of the CPCs to be described in 3.10. When PDL descriptions or functional flow diagrams are not sufficiently communicative, they may be augmented with data flow diagrams, structure charts or other representations. Symbology shall be in accordance with the current edition of The Flowchart Symbols and Their Usage in Information Processing, ANSI X3.1970. If the CPCI is designated to operate in more than one mode (environment), each mode shall be clearly distinguishable in both the text and diagrams.

3.3 Interfaces.- Reference pertinent elements of paragraph 3.1.2 of the STLDD and describe in detail, the essential interface design between the CPCI and other computer programs and hardware with which it must operate. Provide

Figure 3. MODE S Software Detailed Design Document

a detailed logical and quantitative description of all data units, i.e., yards versus meters; all messages; all control signals for defining inter-processor communication techniques; and inter-processor conventions and rules. As appropriate Interface Control Drawings (ICDs) may be incorporated directly or by reference.

3.4 Program interrupts.- List all program interrupts. Each interrupt shall be described concerning source, purpose, type, priority and the required response of the executive control. The program component(s) which service each interrupt shall be listed. The probable rate of occurrence of interrupts shall also be given.

3.5 Timing and sequencing description.- Describe the control logic involved in initiating and terminating the execution of each CPC. This requirement may be satisfied by reference to the appropriate document containing the detailed description of the control logic (e.g., a separately bound document). Timing and sequencing of operation of the CPCs relative to each other shall be described or pictorially depicted. If the sequencing is dynamically controlled during the CPCs operations, the description shall include the method for sequence control and the logic and input conditions of that method. Such factors as timing variations; priority assignments; internal operations such as data transfer in and out of micro processor or disc memory; sensing of discrete input signals, and the timing relationships between interrupt operations within the CPC shall be included. The method used to compute spare timing and the amount of timing allocated as spare shall be described.

3.6 Special control features.- Describe all the special control features that affect the design of the control logic but are not part of the normal operational functions (e.g., system loop tests for routine maintenance).

3.7 Storage allocation.- Graphically portray the relationship of the CPC storage requirements to the total computer equipment storage capability by incorporating, either directly or by reference, a schematic diagram or equivalent representation. This graphic portrayal of the CPC storage shall be accomplished to the level of detail necessary to identify such requirements as data base allocation, computer program allocation, computer program operation allocation, and spare storage allocation. In addition, the timing requirements, sequencing requirements, and equipment constraints used in determining the allocation shall be described. If allocations cannot be specified precisely or portrayed graphically in a manner meaningful for program design, the algorithms used to allocate storage shall be included. Everything in the data base shall be referenced to a storage location when appropriate.

Figure 3. MODE S Software Detailed Design Document

3.7.1 Data base definition.- This paragraph shall include directly or by reference a description of the functional purpose of and a detailed definition of the content and storage location of each file, table, and item that is incorporated in the CPCI data base. This paragraph shall contain the following sub-paragraphs as appropriate:

3.7.1.1 File description.- List all files that have been incorporated in the CPCI data base, including a descriptive title for each file, length of file, format, address in storage and number of tables contained in each file.

3.7.1.2 Table description.- List all tables that have been incorporated in the CPCI data base, including a descriptive title for each table, method of indexing the table, length (words) of table, block format and location of each table within the file.

3.7.1.3 Item description.- List all items contained in the CPCI data base, including for each item, as appropriate, a descriptive title, the most significant bit, number of bits, coding type, scaling factor, units, item value and location of each item within the table.

3.7.1.4 Graphic table description.- Graphically portray the relationship of the items specified in 3.7.1.3 to the tables listed in 3.7.1.2 and the relationship of tables specified in 3.7.1.2 to the files listed in 3.7.1.1. This shall incorporate, in sub-paragraphs as appropriate, either directly or by reference, a diagram or equivalent representation. The graphic portrayal of each table shall be accomplished to the level of detail necessary to identify words per block, untagged items, bits per item, bit allocation, number of blocks, and type of table construction.

3.7.1.5 CPCI constants.- List all constants (e.g., fixed values assigned to the parameters) defined in the MODE S STLDD contained in the CPCI, other than those which are defined as adaptation data, including as a minimum, a description of each constant and its actual numerical or coded value.

3.7.2 CPC relationship.- Show the relationship of the CPCs to the data base. A graphic portrayal may be used to cross index the CPCs to the various tables (e.g., buffers) and items (e.g., constants, control registers) contained in the CPCI data base. This paragraph shall include a list of CPCs specifying for each the storage address when appropriate and number of words/bytes allocated.

Figure 3. MODE S Software Detailed Design Document

3.7.3 Data base location requirements.- This is an optional paragraph which may be used as a single source of the storage location requirements in 3.7.1 and its sub-paragraphs and 3.7.2. A table(s) may be used to satisfy this requirement.

3.8 Object code creation.- This paragraph shall reference paragraph 3.1.1 of the MODE S STLDD and identify the following object code generation requirements:

- a. computer programs required, including but not limited to host operating system, compilers, assemblers, link editors, loaders and libraries;
- b. host computer hardware including minimum configuration, vendor(s), part numbers, and other pertinent data such as model, capacity and special capabilities; and
- c. procedures required to generate object code in the specified media suitable for operation in the target computer.

Note: Procedures may be specified directly, by reference, or in an appendix.

3.9 Adaptation Data.- This paragraph shall be cross-referenced as required to 3.7.1 and shall identify and provide a description of all data and associated entry/initialization procedures required for adaptation of the CPCI to a particular site or mode. A list of the actual data required to adapt the CPCI to the environment associated with each site is required on a site-by-site basis. For convenience, this information may be contained in an Appendix.

3.10 Detail design description.- The individual CPCs shall be described in separate paragraphs as required. This description shall be given at a level of detail that will define the design to permit CPC modification and adaption during operational use of the CPCI. Each CPC shall be described in words and diagrams/charts or through the use of an approved Program Design Language (PDL). When flow charts are used, flow chart symbology shall be in accordance with the current edition of the Flowchart Symbols and Their Usage in Information Processing, ANSI X3.5-1970. Equivalent approved flow representations may also be used but must be supported by a description of conventions and format adequate to allow reader comprehension. There shall be a reference to the instruction listing used (e.g., Book Form Drawing) if not directly incorporated. The delivery of assembly or compilation type data via other acceptable means may be provided with prior approval of the FAA Contracting Officer. For example, storage media suitable for providing the listing may be delivered in lieu of the actual listing. In this case, the reference in this paragraph would be to the controlling number on the table and/or its controlling book form drawing number. The basic paragraph 3.10 shall contain

Figure 3. MODE S Software Detailed Design Document

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the following lead phrase, "This paragraph contains technical descriptions of the computer program components identified in 3.1 of this document. The diagrams, flow charts, or equivalents and instruction listings which specify the exact configuration of the (name of CPCI) are contained in (book form drawing number)." The following sub-paragraphs shall be repeated for each CPC.

3.10.1 Identification of CPC no. n.- Identify the CPC by including, as a minimum, the title, tag (symbolic code), and CPC identification number. Also include a brief abstract of the tasks of the CPC and the language in which it is written, (if different from the basic CPCI language).

3.10.N.1 CPC no. n description.- Describe in words, figures, equations, and references to the diagrams/charts, as appropriate, the operation and design of the CPC. Describe the CPC logic and data flow; equations to be solved; algorithms used to solve these equations; timing and accuracy characteristics; and any special conditions for operation of the CPC. A hierarchy chart shall be used to show the unit calling relationships and to provide a convenient table of contents for the detail design. Equation derivations and numerical analysis shall not be included herein, but may be included in Section 6.

3.10.N.2 CPC no. n charts.- Graphically portray the operations performed by the CPC by use of diagrams, charts, program design language or equivalent graphic presentations that depict overall CPC data processing and control logic. In lieu of direct incorporation, reference may be made to the detail diagrams that identify the CPC. For convenience, the detail diagrams/charts may be assembled under a book form drawing number and controlled as a drawing as agreed between the FAA Contracting Officer and Contractor.

Note: Numbers of diagrams/charts and level of detail required shall be determined based on the above. In general, requirements for numbers and detail of charts should be held to the minimum adequate to facilitate understanding of the information flow and maintenance of the CPCI during its operational use.

3.10.N.3 CPC no. n interfaces.- Describe the relationship of the CPC to other CPCs, to that part of the data base external to the CPC and where applicable to their CPCIs. At a minimum, this paragraph shall include the following:

a. The set-use matrix, table, item, buffer definitive information and input/output format information.

Figure 3. MODE S Software Detailed Design Document

b. Unique CPC interfaces that, because of their nature, composition, use or meaning, require an individual definition.

3.10.N.4 CPC no. n data organization.- This paragraph shall contain or reference, as appropriate, a list and description of all data items and tables which are unique to the CPC; when possible, describe the areas of memory available for temporary storage; and list all constants, symbols and internally defined variables together with their definitions and meaning.

3.10.N.5 CPC no. n limitations.- This paragraph shall summarize any known or anticipated limitations of the CPC. A listing of all restrictions and constraints which apply to the CPC shall be provided, including timing, limitations of algorithms and formulas used, limits of input and output data, associated error correction sensing, and error checks programmed into the routines.

3.10.N.6 CPC no. n listing.- This paragraph shall contain or reference (book form drawing if appropriate) the complete source listing of instructions contained in the CPC. The listing shall show the relationship to the charts by appropriate use of statement labels or tags. Comments of explanation shall be included and considered part of the listing. A self-documenting listing may be used if a preamble together with adequate commenting and clear indentation provides a complete detail design description. Assembling listings under a (book form) drawing number or by other means shall be as agreed between the FAA Contracting Officer and the contractor (see 3.10). The listings shall be completed in sufficient detail to permit all necessary CPC and CPCI maintenance actions.

3.11 Program listing comments.- The following is an example of an approved format for program listing comments. The exact format and level of detail for comments shall be as agreed between the FAA Contracting Officer and the contractor.

"As a minimum source code program listings shall contain three types of in-line comments as defined herein. These are BANNERS, HEADERS, and SPECIAL COMMENTS".

-SAMPLE FORMAT-

a. BANNERS. A BANNER shall be a block of consecutive comments which appears once at the beginning of each CPC. BANNERS shall have an identical format for all CPCs and shall contain the following information: CPCI title and CPC title. The CPC-BANNER occurs once in the program listings and immediately preceeds the CPC-HEADER.

Figure 3. MODE S Software Detailed Design Document

b. HEADERS. Shall consist of a block of consecutive comments arranged to facilitate the understanding and readability of the CPC. This form of block commenting shall be used in lieu of individual comments being scattered throughout the CPC. HEADERS shall occur once at the beginning of each CPC. The observer shall be able to read the CPC-HEADER and understand the processing activities of the program without having to read program code. The CPC-HEADER shall be a set of consecutive comments which contain a descriptive abstract of the CPC. The minimum required CPC-HEADER comments are described below. These comments shall appear in the form and in the order as illustrated.

- (1) CPC-NAME - Followed by a one line functional description.
- (2) PROLOGUE - Multiple comments which synopsise the CPC purpose and usage. The prologue should address the processing activities of the CPC in prose form. Elaboration on the technical aspects of the algorithms may be avoided by referencing external documentation. References to all existing documentation shall be listed in the REFERENCES comment section after the PROLOGUE.
- (3) REFERENCES - NO-1. TITLE, DATE (YY/MM/DD), section/paragraph. No-2, etc.
- (4) INPUTS - Local and Global Data Items, Tables, Files and other data input sources shall be identified individually as to unit of measure, range of data, accuracy or precision requirements, frequency of arrival.
- (5) OUTPUT - Local and Global Data Items, Tables, Files and other data output sources shall be identified in the same manner as inputs.
- (6) RELATED PROGRAMS - Name of other CPCs that call or are called by this CPC followed by brief abstract of purpose and pre/post conditions of each call.
- (7) LIMITATIONS - Description of any constraints upon the execution of the CPC. For instance, conditions which would alter the logical operation of the CPC or cause the results of the CPCs computations to be altered.
- (8) VERSION - Indicate the date and version number of this release of the CPC.

Figure 3. MODE S Software Detailed Design Document

c. SPECIAL COMMENTS. If an instruction statement of code is particularly subtle or confusing, SPECIAL COMMENTS shall precede the statement(s) to describe its processing function. SPECIAL COMMENTS are provided only to aid the observer in reading CPC code and are not intended to replace CPC HEADER comments.

SECTION 4. QUALITY ASSURANCE PROVISIONS

This section shall reference the test plans and procedures that were used for the qualification of the CPCI and provide the basis for CPCI acceptance by the FAA Contracting Officer. This section shall reference and/or specify those tests which are applicable to the reproduction of the CPCI. This section shall also describe any special simulation capabilities required for checking CPCI design.

4.1 Test plan/procedure cross-reference index.- In this paragraph, the relationship of the CPCI functions to their test plan and test procedure documentation shall be referenced by cross-reference indexing. This paragraph shall also reference any special test tools or capabilities (e.g., simulation) that were required to test the CPCI functions.

4.2 Other quality assurance provisions.- This paragraph shall reference and/or specify the test-verification/validation requirements, methods and procedures which apply to preparation and duplication of the CPCI (e.g., disks, tapes, etc.). Conformance inspection and verification of the requirements of Section 5 shall be included herein.

SECTION 5. PREPARATION FOR DELIVERY

This section shall specify, in sub-paragraphs as appropriate, the requirements for packaging, marking, and otherwise preparing the CPCI for shipment and storage. Where suitable existing Government or commercial specifications are used, they shall be incorporated by reference in lieu of providing duplicate detailed requirements in this section. Where suitable specifications do not exist, requirements peculiar to the CPCI shall be specified in appropriate sub-paragraphs.

5.1 Preservation and packaging.- Describe the preparation for delivery requirements of the CPCI. Packaging requirements include a description of the product packaging (disks, tapes, manuals, etc.), preservation methods, and packing involved in preparing the CPCI for shipment and storage. Special handling requirements or other special considerations shall be included (e.g., when shipping magnetic storage media, special EMI requirements shall be delineated). The delivery medium and the drawing, as appropriate, specifying the delivery medium shall also be specified in this paragraph. Preservation and packaging shall be accomplished in accordance with "best commercial practice".

Figure 3. MODE S Software Detailed Design Document

5.2 Markings.- Specify in detail the content and physical location of identification markings which are to appear on the package(s) that make up the deliverable CPCI. For example, the markings on tape leaders, tape canisters, disk packs, etc. Markings shall be accomplished in accordance with "best commercial practice".

SECTION 6. NOTES

This section of the SDDD is not contractually binding, and should not contain contractual requirements. It may include information of particular importance to the MODE S Program Office in using the SDDD as a contractual instrument, or administrative or background information (e.g., ordering instructions for technical data pertaining to the CPCI, or specific information related to the use of the program in future assembly and integration testing). It shall not include requirements which constrain design, development, or qualification of the CPCI. The text shall be preceded with the statement "Administration Information Only - Not Contractually Binding." This section may reflect the technical manuals which can be singularly and peculiarly identified with the CPCI, and which are necessary to its operation and maintenance. This section may include any pertinent information not included in the above paragraphs, such as the rationale behind the design reference material in support of the algorithms used, and the pertinent tests which were performed to verify the final design of the CPCI, with key test results included or referenced. Material which is a mandatory requirement for inclusion in Section 6 will be specified by the FAA Contracting Officer.

SECTION 7, 8 & 9 Not used

SECTION 10. APPENDIX

If used, this section of the SDDD shall contain only those requirements which are contractually a part of the SDDD, but are bound separately for convenience, such as listings, charts, decision tables, multi-site adaptation requirements, temporary/limited effectivity requirements and classified data. Each Appendix shall be referenced in the main body of the specification where the data would normally have been placed. Appendices shall be numbered in increments of 10 (i.e., 10, 20, 30, 40, etc.).

Figure 3. MODE S Software Detailed Design Document

PART 4

Software Test Plan

1. PURPOSE

The purpose of the software test plan is to establish detailed qualification requirements, criteria, general methods, responsibilities, and overall planning for the qualification of each MODE S CPCI and for sub-elements of the CPCI.

2. INSTRUCTIONS FOR PREPARATION OF SOFTWARE TEST PLANS

Contents of the software test plans shall be prepared in accordance with Appendix I and arranged in accordance with the instructions, format and paragraph headings described in Figure 4. Deviations from the requirements stated herein require approval of the FAA Contracting Officer prior to implementation.

3. DETAILED INSTRUCTIONS FOR PREPARATION OF SOFTWARE TEST PLANS

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Figure 4. Software Test Plan

SECTION 1. PURPOSE

This section shall state the purpose of the Software Test Plan and shall identify the CPCI to which it applies by CPCI number and the approved identification specified in the FRD. The purpose shall be stated in terms of establishing detailed requirements, criteria, general methods; responsibilities, and overall planning to confirm, in accordance with Section 4 of the MODE S STLDD, that the CPCI or designated portions of it, fulfills the requirements of Section 3 of the MODE S STLDD. Reasons for excluding any portions of the CPCI from this test plan shall be stated.

SECTION 2. REFERENCES

This section shall list all documents upon which the CPCI Test Plan is based or which relate significantly to the CPCI test effort. Documents defining the CPCI configuration to which the test plan applies shall be specifically identified.

SECTION 3. TEST CONCEPTS

This section shall contain background information required to substantiate the test philosophy and to provide information to aid in understanding and evaluating the test plan.

SECTION 4. QUALIFICATION REQUIREMENTS AND CRITERIA

a. This section shall contain detailed qualification requirements based on Section 4 of the MODE S STLDD. For ease in preparation and use, information required in this section may be published as appendices or additional volumes of the test plan; such appendices or volumes shall be considered to be an integral part of the test plan and shall be referenced in this section.

b. In addition to the detail identification of performance requirements, parameters shall be stated in terms of presence or absence of specified outputs and, wherever applicable, in terms of tolerance limits for calculated values. Methods of determining whether CPCI performance corresponds to the parameters shall be stated for each requirement. Methods may include, for example, an analysis of recorded data, examination of displays or hard-copy outputs, or equipment response to operation of the CPCI.

c. Situations or conditions under which qualification must be achieved shall be specified in terms of ranges of input data values, amount of input data of required types, and specific critical values or occurrences.

Figure 4. Software Test Plan

SECTION 5. QUALIFICATION OBJECTIVE/TEST PHASE SUMMARY

This section shall identify qualification requirements to be satisfied by (1) data from computer program test and evaluation, (2) preliminary qualification testing, (3) formal qualification testing, and (4) system testing. Detailed requirements shall be identified by references to Section 4 above and shall be contained in sub-sections shown below. Depending on the nature of the requirements, it may appear in more than one of the following sub-sections.

5.1 Requirements to be satisfied by computer program test and evaluation data.- This sub-section shall list the CPCI qualification requirements to be satisfied by data from computer program test and evaluation and shall identify the data to be supplied for such qualification.

5.2 Requirements to be satisfied by preliminary qualification testing.- This sub-section shall list the CPCI qualification requirements against which the operation of the CPCI program is to be verified during preliminary qualification testing and shall identify the data to be supplied for such qualification.

5.3 Requirements to be satisfied by formal qualification testing.- This sub-section shall list the CPCI qualification requirements to be satisfied during formal qualification testing and shall identify the data to be supplied for such qualification.

5.4 Requirements to be satisfied during system testing.- This sub-section shall list the CPCI qualification requirements which, by their nature, cannot be satisfied prior to system testing.

SECTION 6. CPCI QUALIFICATION TEST IMPLEMENTATION

This section shall contain the plan for implementation of the CPCI preliminary and formal qualification tests. Sub-section 6.1 shall apply to preliminary qualification tests and sub-section 6.2 shall apply to formal qualification tests. Each sub-section shall contain:

6.N.1 Location and schedule.- The location at which the qualification tests will be conducted shall be specified. The schedule for the tests shall be established in terms of dates for particular tests or sets of tests, general periods (weeks or months) for various tests or phases of testing, or periods relative to milestones in the overall contract schedule.

6.N.2 Limitations and general comments.- General comments and limitations relative to test implementation and accomplishment of test objectives shall be included.

Figure 4. Software Test Plan

6.N.3 Preparation of inputs.- General methods for preparation of input data shall be described. This shall include identification of simulation and/or data generation vehicles to be used. Requirements for review or validation of input data shall be specified.

6.N.4 Conduct of the tests.- General procedures for test conduct and delineation of responsibilities for test direction, operation, and observation shall be established.

6.N.5 Analysis of results.- General procedures for analysis of test results shall be described. This shall include identification of computer programs to be used for data reduction/analysis.

6.N.6 Summarization of equipment and computer program requirements.- Requirements for computer programs, other than the CPCI being tested, and for equipment such as computers, supporting equipment, etc., shall be summarized. This information shall correspond to requirements set forth in 4.1 of the MOD'S STLOD.

6.N.7 Summarization of personnel requirements.- Personnel requirements shall be summarized. This shall include statements describing responsibilities, authority, and particular knowledge of skills required. The extent of this summary shall be such that provisions for supplying personnel will be consistent with a meaningful, successful qualification effort.

SECTION 7. CONTROL AND REPORTING PROCEDURES

This section shall specify requirements and procedures for controlling and documenting the CPCI Test Program. These procedures and requirements shall be specified in sub-sections as follows:

7.1 Control of the CPCI test program.- This sub-section shall contain procedures for revising or updating the CPCI Test Plan as a result of schedule changes, changes to design requirements and/or CPCI detail design, revised provisions for supporting the test program, etc. Interrelation between the CPCI Test Program and control of the CPCI design requirements and/or configuration shall be established.

7.2 Documentation of test procedures.- This sub-section shall specify requirements and procedures for preparing, reviewing, and revising test procedures.

Figure 4. Software Test Plan

7.3 Documentation of test reports.- This sub-section shall specify requirements and procedures for preparing and reviewing reports of individual qualification tests, summaries of the CPCI Test Program and/or its phases, and other reports which may be required related to the CPCI Test Program.

Figure 4. Software Test Plan

PART 5

Software Test Procedures

1. PURPOSE

Software test procedures are developed in recognition of MODE S STILDD and Software Test Plan requirements. They present detailed instructions for test set-up, execution, and evaluation of test results. The procedures state in general terms the organization or structure of the test and any assumptions or constraints placed on its usage. They describe the required equipment, manpower, computer programs, and supporting documentation. If various modes of operation are possible the requirements for each are specified. Equipment required for operation is identified and revisions or modifications to the equipment is specified as well as any pre-test check-out required to ensure a valid test environment.

2. INSTRUCTIONS FOR PREPARATION OF SOFTWARE TEST PROCEDURES

Contents of the software test procedures shall be prepared in accordance with Appendix I and arranged in accordance with the instructions, format and paragraph headings described in Figure 5. Deviation from the requirements stated herein require approval of the FAA Contracting Officer prior to implementation.

3. DETAILED INSTRUCTIONS FOR PREPARATION OF SOFTWARE TEST PROCEDURES

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Figure 5. Software Test Procedure

SECTION 1. PURPOSE

This section shall state the following:

1.1 Test identification.- The individual test shall be uniquely identified and shall be indicated as being a preliminary or formal qualification test.

1.2 Item identification.- The CPCI to which the test applies shall be identified by CPCI number and the approved identification specified in the FRD.

1.3 Primary function.- The CPCIs primary functions or segments which are to be tested shall be identified.

SECTION 2. LOCATION AND SCHEDULE

The location and schedule shall be provided for pre-test briefings, test, post-test debriefings and data reduction/analysis activities.

SECTION 3. REFERENCES

Reference documents applicable to the test shall be listed including the applicable Software Test Plan, MODE S STLDD, Software Users Manual and users manuals for test/support computer programs and equipment.

SECTION 4. TEST OBJECTIVES

Detailed objectives of the test shall be indicated by brief function descriptions and references to Section 4 of the CPCI Test Plan.

SECTION 5. PERSONNEL AND RESPONSIBILITIES

Requirements and responsibilities shall be provided for console operators, test directors, technical consultants, data analysts, or other essential test personnel. Special knowledge or skills required shall be stated. Requirements which are identical to those stated in Section 6 of the CPCI Test Plan may be specified by reference to the test plan.

SECTION 6. EQUIPMENT AND COMPUTER PROGRAM REQUIREMENTS

Requirements for computer programs, other than the CPCI being tested, and for equipment necessary to support the test shall be specified. Requirements identical to those stated in Section 5 of the CPCI Test Plan may be specified by reference to the test plan.

Figure 5. Software Test Procedure

SECTION 7. TEST OPERATING PROCEDURES

Procedures for operating the CPCI to be tested shall be specified in this section. Procedures shall be specified to:

7.1 Initiate the CPCI operation.- Procedures shall be specified to read the CPCI into the computer, establish the required mode of operation, initially set required parameters, provide for required inputs, and outputs, and begin operation of the CPCI. Listings of input material to accomplish the above shall be provided as an appendix.

7.2 Maintain the CPCI operation.- Procedures shall be specified to maintain operation of the CPCI whenever operator intervention is required as, for example, to maintain input data flow and replenish tape supplies.

7.3 Terminate and restart the CPCI operation.- Procedures shall be specified for normal and unscheduled termination of CPCI operation, as well as restarting CPCI operation so as to insure that necessary output data is obtained and made available for required evaluation.

SECTION 8. DETAILED TEST DESCRIPTION

This section shall describe in detail the test outputs, events and expected results. Test objectives satisfied or partially satisfied by each expected result shall be identified by reference to Section 4 of the CPCI Test Plan. Test events shall be described in the order in which they are planned to occur with dependency of any one event on another so indicated. If more than one operating or monitoring position is involved in the test, the sequence of events for each position shall be indicated. Interdependence of operating positions with respect to specific events shall be described. Listings of test inputs and/or listings produced in the preparation of test inputs shall be included in an appendix.

SECTION 9. DATA REDUCTION AND ANALYSIS

This section shall contain the requirements and procedures for reduction and analysis of test data. The information shall be contained in sub-sections as follows:

9.1 Recording and reduction requirements.- Data which must be recorded during the test by the CPCI, manually, and/or by instrumentation shall be specified. In addition, requirements for format and content of the data resulting from the

Figure 5. Software Test Procedure

reduction/analysis process shall be specified. Requirements for data recording and reduction shall be specified in a manner and detail such that the resulting information will clearly show whether the test objectives have been met.

9.2 Data reduction/analysis procedures.- This sub-section shall contain the procedures to be employed in reducing and analyzing data resulting from the test. Reduction and/or analysis to be accomplished by computer programs shall be identified. Procedures for operating such programs shall be specified to:

9.2.1 Initiate the CPCI operation.- Procedures shall be specified to read the CPCI into the computer, establish the required mode of operation, initially set required parameters, provide for required inputs and outputs, and begin operation of the CPCI. Listings of input material to accomplish the above shall be provided in an appendix.

9.2.2 Maintain the CPCI operation.- Procedures shall be specified to maintain operation of the CPCI whenever operator intervention is required to maintain input data flow and tape supplies.

9.2.3 Terminate and restart the CPCI operation.- Procedures shall be specified for normal and unscheduled termination of CPCI operation, as well as restarting CPCI operation so as to ensure that necessary output data are obtained and made available for required evaluation. Reduction and/or analysis to be accomplished manually shall be identified, and procedures shall be established for accomplishment.

Figure 5. Software Test Procedure

PART 6

Software Test Report

1. PURPOSE

CPCI test results are accumulated during preliminary and formal qualification testing. On completion of the qualification testing the results are integrated to report a summary of the total CPCI qualification test process.

2. INSTRUCTIONS FOR PREPARATION OF SOFTWARE TEST REPORTS

Contents of software test reports shall be prepared in accordance with Appendix I and arranged in accordance with the instructions, format and paragraph heading described in Figure 6. Deviation from the requirements stated herein require approval of the FAA Contracting Officer prior to implementation.

3. DETAILED INSTRUCTIONS FOR PREPARATION OF SOFTWARE TEST REPORTS

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Figure 6. Software Test Report

SECTION 1. CPCI IDENTIFICATION

The CPCI to which the test applies shall be identified by CPCI number and the approved identification specified by the FRD.

SECTION 2. TEST IDENTIFICATION

The identification of the individual qualification test as shown on the test procedure shall be shown on the test report.

SECTION 3. PRIMARY FUNCTION

The CPCI's primary functions or segments to which the test applies shall be identified.

SECTION 4. TEST PLAN AND PROCEDURES REFERENCE

The Software Test Plan and the Software Test Procedures for the test as specified in 4.1 of the SDDD shall be referenced.

SECTION 5. TEST RESULTS

The results of the test shall be stated as follows:

a. Identification of those planned objectives for which actual test results were identical with the expected results as specified in the test procedures, or for which variation between actual and expected results was within specified tolerances. In the latter case, actual test results shall be shown.

b. Identification of those planned objectives for which actual test results differed from expected results beyond specified limits. In this case, actual test results shall be shown.

c. Identification of any planned test objectives for which actual results were not obtained. Reason for not fulfilling such objectives shall be stated.

SECTION 6. RECOMMENDATIONS

Recommendations for subsequent action shall be stated, based on the test results. Such recommendations may include:

a. Revising the CPCI in order to meet specifically identified requirements which were not fulfilled.

Figure 6. Software Test Report

- b. Revising the MODE S STLDD in cases where the test results disclose ambiguity or conflicting requirements.
- c. Conducting additional tests to fulfill objectives for which results were not as expected.
- d. Qualifying those functions for which test objectives have been fulfilled.

Figure 6. Software Test Report

PART 7

Version Description Document

1. PURPOSE

The Version Description Document identifies the exact physical configuration (version) of a computer program configuration item (CPCI) and interim changes thereto. It accompanies each CPCI version and interim version released.

2. INSTRUCTIONS FOR PREPARATION OF VERSION DESCRIPTION DOCUMENTS (VDDs)

Contents of the VDDs shall be prepared in accordance with Appendix I and arranged in accordance with the instructions, format and paragraph headings described in Figure 7. Deviations from the requirements stated herein require approval of the FAA Contracting Officer prior to implementation.

3. DETAILED INSTRUCTION FOR PREPARING VERSION DESCRIPTION DOCUMENTS

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Figure 7. Version Description Document

SECTION 1. SCOPE

1.1 Identification.- Include the following:

- a. CPCI title/name
- b. System title
- c. CPCI number
- d. CPCI STLDD number
- e. For each release of a new CPCI version, identify the new version number.
- f. For the release of an interim version, identify the Government approved engineering change request number that authorized the revision resulting in the interim version, the Government approved engineering change request number that identifies the revisions to the CPCI STLDD, and a reference to the current CPCI version for which it is to be attached.

1.2 Introduction.- This paragraph shall contain a top-level summary of the content of the VDD.

SECTION 2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.2 Non-government documents.- (Identify the source within the contractor's organization from whom the documents can be obtained.)

SECTION 3. INVENTORY OF MATERIALS RELEASED

List all items (tapes, disks) covered by the VDD by CPCI number and version number or CPCI number and interim version number and the Government approved engineering change request (ECR) number authorizing the changes resulting in the interim version in the case where a new version is not necessary. In addition, identification shall be made of all utility and/or support computer program release documents which are not a part of the released items but which are required to operate, load, or regenerate the released CPCI.

SECTION 4. INVENTORY OF CPCI CONTENTS

Identify all CPCI data content, either by reference to appropriate specification documents and manuals and/or by listings, which are being released.

SECTION 5. CHANGES INSTALLED.

Identify all new changes reflected in the CPCI version and/or interim version incorporated since the release of the previous version. For each new change,

Figure 7. Version Description Document

identify the ECR number and date, and any related ECR number and date, and provide a concise corresponding technical description of each change, the impact on system performance, and either directly or by reference, results of testing the change. This information does not apply to an initial release.

SECTION 6. ADAPTATION DATA

For the release of a new CPCI version, identify (by reference to appropriate specification documents and/or listings) all unique-to-site data which are contained in the items being released. For a CPCI version subsequent to the initial version (including interim versions), this section shall also contain the necessary information on changes which have been made to the adaptation data.

SECTION 7. INTERFACE COMPATIBILITY

For a release of a new CPCI version, indicate other systems and/or CIs affected by the changes incorporated in this new release. For the release of an interim version to a CPCI, indicate other systems and/or CIs affected by the change.

SECTION 8. OPERATIONAL DESCRIPTION

For each change listed in Section 5 above, there will be a sub-section identifying the operational effect of the change.

SECTION 9. INSTALLATION INSTRUCTIONS

Describe (either directly or by reference) the method to be used to install and checkout the delivered CPCI version or interim version.

Figure 7. Version Description Document

PART 8

Software Users Manual

1. PURPOSE

The purpose of the software users manual is to provide user personnel with the instructions necessary to execute a computer program configuration item (CPCI). The manual content and format shall be specifically designed to meet the needs of those who are responsible for execution of specific CPCI functions.

2. INSTRUCTIONS FOR PREPARATION OF SOFTWARE USERS MANUALS

Contents of the manuals shall be prepared in accordance with Appendix I and arranged in accordance with the instructions, format and paragraph headings described in Figure 8. The manual shall be as self-contained as possible with minimal references to other documents. However, where it is necessary to incorporate data in the software users manual that is identical to that specified in the software detailed design document (SDDD), the data shall be incorporated by reference to the specific SDDD data in order to avoid redundancy. Charts, tables, checklists and illustrations shall be used in lieu of written text whenever practical. Discussion of theory shall be omitted except where essential for practical understanding and application. Primary emphasis shall be placed on the specific steps to be followed, the results which may be expected or desired, and the corrective measures required when such results are not obtained. Deviations from the requirements stated herein require approval of the FAA Contracting Officer prior to implementation.

3. DETAILED INSTRUCTIONS FOR PREPARATION OF A SOFTWARE USERS MANUAL

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Figure 8. Software Users Manual

SECTION 1. SCOPE

This section shall consist of the following:

1.1 Identification.- This section shall identify the CPCI by CPCI number and the approved identification specified in the FRD. It shall contain a brief description of the manual's purpose, scope, organization and content.

1.2 Introduction.- This section shall describe the CPCI and the Mode S subsystem within which the CPCI operates. It shall include:

a. Mode S subsystem description.- This paragraph shall provide a comprehensive description of the Mode S subsystem within which the CPCI is a component to include an overview of the subsystem structure and its operation. Also identify all equipment and software required to support the CPCI operation.

b. CPCI description.- This paragraph shall describe the purpose of the CPCI, the specific functions performed by the CPCI, its internal structure to the computer program component (CPC) level and the specific function each CPC performs, data base usage, interfaces and control mechanisms with other CPCI's, and operating characteristics.

SECTION 2. APPLICABLE DOCUMENTS

This section shall include a list of referenced documents (identified by title, number, and date of issue and revision).

2.1 Government documents.

2.2 Non-government documents.- (Identify the source within the contractor's organization from whom the documents can be obtained.)

SECTION 3. FUNCTIONAL REQUIREMENTS

This section shall describe each specific function of the CPCI. The following paragraphs shall be repeated for each function.

a. Title of function.- Provide a descriptive title of the specific function.

b. Description of function.- Provide a summary description of the specific function, including:

- 1) Purpose and uses of function
- 2) Description of system inputs
- 3) Description of expected outputs and results
- 4) Relationship to other functions
- 5) Function options
- 6) Summary of function operation, including initiation, termination and other control procedures
- 7) Data base usage

SECTION 4. FUNCTIONAL USE INSTRUCTIONS

This section shall explain how to use each specific function. It shall include the following:

a. Preparation of inputs.- A definition of the system inputs, other than those required to operate the CPCI (see 5.2), that constitute the basic data that are to be processed by the CPCI. The definition shall include:

- 1) Titles of inputs
- 2) Description of inputs
- 3) Purpose and use
- 4) Input media
- 5) Limitation/restrictions
- 6) Format and content
- 7) Sequencing
- 8) Special instructions
- 9) Relationship of inputs to outputs
- 10) Examples

b. Results of operation.- A definition of expected results for completion of a CPCI operation including:

- 1) Description of results
- 2) Form in which results will appear
- 3) Output format and content
- 4) Instruction on disposition and use of outputs
- 5) Limitations/restrictions
- 6) Relationship of outputs to inputs
- 7) Examples

SECTION 5. OPERATING INSTRUCTIONS

This section shall include the procedures required to operate the CPCI and shall include the following.

5.1 Operating procedures.- The step-by-step procedures required to:

- a. Initiate the system and CPCI.- Procedures shall include reading the CPCI into the computer, establishing the required mode of operation (if more than one), initially setting required parameters and sense switches, providing for inputs and outputs, mounting tapes or disks, and operating the CPCI.
- b. Maintain CPCI operation.- Procedures shall be specified to maintain operation of the CPCI where operator intervention is required. Identify all man-machine interfaces, including on-line inputs.
- c. Terminate and restart the CPCI.- Procedures shall be specified for normal and unscheduled termination of CPCI operation, as well as restarting the CPCI.
- d. Software system generation procedures.- This section shall include both the routine intervention required and such special topics as procedures to enable operators and/or programmers to "patch" corrections or to change the CPCI without recompiling the program or building a new master software storage media.

5.2 Operator inputs.- A complete description of all the inputs required to operate the CPCI other than those described in paragraph 4a, shall be defined in a similar manner as follows:

- a. Title of inputs
- b. Purpose of use
- c. Limitations/restrictions
- d. Format and content

5.3 Expected outputs.- A complete description of the output formats of the CPCI, other than those described in paragraph 4b shall be defined. These shall include samples of each type of possible output format. Furthermore, a cross-reference list between output fields and input control fields shall be provided, so the CPCI user may readily determine the effect of certain input fields on each output field. This sub-paragraph shall include, but not be limited to, the following:

- a. Title of output
- b. Purpose and use
- c. Output media
- d. Output format
- e. Output content (symbols, codes, etc.)

SECTION 6. APPENDICES

Appendices may be used for examples and listings as required.

PART 9

Software Maintenance Manual

1. PURPOSE

The purpose of the Software Maintenance Manual is to provide maintenance programmer personnel with the information necessary to effectively maintain each computer program configuration item (CPCI) of the Mode S System.

2. INSTRUCTIONS FOR PREPARATION OF SOFTWARE MAINTENANCE MANUAL

Contents of the software maintenance manual shall be prepared in accordance with Appendix I and arranged in accordance with the instructions, format and paragraph headings described in Figure 9. Deviations from the requirements stated herein require approval of the FAA Contracting Officer prior to implementation.

Each CPCI and its computer program components (CPCs) shall be completely described to a level of detail sufficient to permit personnel not associated with the CPCI development to understand the structure, functions, and operation of the CPCI. Emphasis shall be placed on elements of the CPCI which may be subject to future modification or subject to stress in peak load operating environments. Where it is necessary to incorporate data in the software maintenance manual that is identical to that specified in the software detailed design document (SDDD), the data shall be incorporated by reference to the specific SDDD data in order to avoid redundancy.

3. DETAILED INSTRUCTIONS FOR PREPARATION OF SOFTWARE MAINTENANCE MANUALS

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Figure 9. Software Maintenance Manual

SECTION 1. SCOPE

This section shall consist of the following:

1.1 Identification.- This section shall contain a brief description of the manual's purpose, scope, organization and content.

1.2 Introduction.- This section shall describe the Mode S System and each CPCI used as part of or in support of the Mode S System. It shall include:

a. Mode S system description.- This paragraph shall provide a comprehensive description of the Mode S System and its subsystems in terms of their overall functions. This description shall be accompanied by a chart showing the inter-relationships of the major components of the system.

b. CPCI description.- This paragraph shall describe the details and characteristics of each CPCI and its respective computer program components (CPCs), modules and sub-routines that would be of value to a maintenance programmer in understanding the CPCI and its relationship to other CPCIs. Special maintenance CPCIs used for maintaining the Mode S System shall be discussed under 3.4. This paragraph shall initially contain a list of all CPCIs to be discussed, followed by a narrative description of each CPCI and its respective CPCs, modules and sub-routines under separate paragraphs starting with 1.2.1 through 1.2.n. Information to be included in the narrative description is represented by the following items:

1. CPCI title or tag and version number as identified in the software detail design document.
2. Description of CPCI functions.
3. Storage - Specify the amount of storage required to use the CPCI and the parameters of the storage locations needed for all data, tables, constants, etc.
4. Data file records used by the CPCI during operation.
5. Branching conditions and locations provided in the CPCI.
6. Entry requirements for initiation of the CPCI.
7. Input data parameters and location(s) used by the CPCI when its operation begins.
8. Exit requirements for termination of the operation of the CPCI.

Figure 9. Software Maintenance Manual

9. System conditions and linkage to the next logical CPCI (operational, control).
10. Output data parameters and location(s) produced by the CPCI for use by related processing segments of the system.
11. Response to errors detected during the input-processing-output operations of the CPCI.
12. Restrictions that have been designed into the system with respect to the operation of this CPCI, or any limitation on the use of the CPCI.
13. Permanency - Note whether the CPCI is a normal link in the cycle of CPCIs to be run or will be used only under certain circumstances.
14. Associated CPCIs - Identify the CPCIs which can access this CPCI.
15. Major operations - Describe the major operations of each CPCI. The description shall be referenced to PDL description(s) or flowchart(s) which may be included in an appendix. The PDL description(s) and flowchart(s) shall show the general logical flow of operations, such as access an input, access a data record, major decision, and produce an output, which would be represented by CPCs within the CPCI. Reference may be made to included PDL descriptions or flowcharts that present each major operation in more detail.

SECTION 2. INPUT/OUTPUT DESCRIPTIONS

This section shall provide information on the structure and composition of the system data as specified in the SDDD.

2.1 General description.- This paragraph shall provide a general presentation of the inputs and outputs and their characteristics in support of the Mode S system operation and maintained by the Mode S system.

2.2 Characteristics, organization and detailed description of system data.

2.2.1 General characteristics.- Information in this paragraph shall include a complete description of the nature and content of each of the input/output components that make up the system data. The following are examples of this type of information:

a. Identification.- Name and mnemonic reference of the component (e.g., data base). List the CPCIs utilizing the component.

b. Function.- Explain the use of the component in the MODE S system.

c. Content.- Describe the type of data it holds and its technical characteristics. This may be operational data (input data, output information, reference data), internal data such as results of intermediate processing or directory information (routing/linkage tables) that enables a CPCI to locate other records or to communicate with other CPCIs.

d. Permanency.- State whether the component contains static (parametric) data that a CPCI can reference but may not change or dynamic data that can be changed or updated during Mode S system operation. Indicate whether the change is periodic or random as a function of input data.

e. Storage.- Specify the location(s) in which the data base information is held (e.g., tape, disk, internal storage) and the amount of storage required.

f. Associated CPCIs.- Identify the CPCIs which can access this component during their operation. Indicate if the CPCI only reads data or may also write new data into the record.

g. Restrictions.- Explain any limitations on the use of this component by each of the CPCIs in the Mode S system.

2.2.2 Organization and detailed description.- This paragraph shall define the internal structure of each input/output component. An example of each shall be shown and its composition, such as records and tables, shall be explained. The following items indicate the type of information required:

a. Layout.- Show the structure of the subject record.

b. Sections.- Note whether the physical record is a logical record or one of several that constitute the complete logical record. Identify the record parts, such as header or control segments and the body of the record.

c. Fields.- Identify each field of data provided in the record structure and explain its purpose.

d. Tags/labels.- Indicate the tag or label assigned to reference each field of data.

e. Size.- Indicate the length and number of bits/characters that make up each data field.

f. Range.- Indicate the range of acceptable values for the field entry, if a numeric.

g. Expansion.- Note provisions if any, for adding data fields to the record.

2.3 Tables.- The tables within each CPCI of the Mode S system shall be explained and described. Reference may be made to the CPCI listing, however this paragraph shall provide the information necessary to understand the use of the tables specified in that listing. The information shall include:

- a. Table tag, label or symbolic name.
- b. Full name or purpose of the table.
- c. CPCI that uses this table.
- d. Logical divisions within the table (internal table blocks or parts - not entries).
- e. Basic table structure (fixed or variable length, fixed or variable entry structure).
- f. Table layout (a graphic presentation shall be used). Included in supporting description shall be table control information, details of the structure of each type of entry, unique or significant characteristics of the use of the table.

2.4 Items.- As used in this paragraph, the word "item" refers to a specific category of detailed information that has a defined position within a table and that is coded for direct and immediate manipulation by a CPCI. Used in this sense, the definition of an item is machine and program oriented rather than operationally oriented. This information shall be presented within the description of the table that contains the item. Of primary importance is an explanation of the use of each item. Item definitions shall include:

- a. Item tag or label and full name.
- b. Table in which it is found.
- c. Position in table (word number and bit position/level number/etc.)
- d. Item use: e.g., table control item, entry structure, key item, string control item, data item.
- e. Purpose of the item.
- f. Item coding, depending on the item type. For example:

- (1) Symbolic - character code used.
- (2) Integer - binary or binary coded decimal.
- (3) Fraction - scaling factor.
- (4) Mixed number, fixed point - point position.
- (5) Status - the maximum number of conditions, form of status values (symbolic or numeric binary), a list of all acceptable status values or conditions.

g. Accessibility factor - coded to indicate machine instruction modifiers that can expedite retrieving and storing of the item; e.g., FW (full word), LHW or RHW (left-or-right-hand word), B (byte size), M (mask necessary), etc.

SECTION 3. PROGRAM ASSEMBLING, LOADING AND MAINTENANCE PROCEDURES

Section 3 shall provide information on the specific procedures necessary for the programmer to maintain the CPCIs of the Mode S system.

3.1 Input/output requirements.- Included in this paragraph shall be the requirements concerning the equipment and materials needed to support the necessary maintenance tasks. Materials shall, for example, include the inputs for loading a maintenance CPI and the inputs which represent the changes to be made. When a support system is being used, this paragraph shall reference the appropriate manual.

3.2 Procedures.- The procedures, presented in a step-by-step manner, shall detail the method of preparing the inputs, such as the data entry, structuring, and sequencing of inputs. The operations or steps to be followed in setting up, running, and terminating the maintenance task on the equipment shall be given.

3.3 Verification.- This paragraph shall include those requirements and procedures necessary to check the performance of a CPI section following its modification.

3.4 Special maintenance programs.- This paragraph shall contain an inventory and description of any special CPCIs used to maintain the MODE S system.

3.5 Other special maintenance procedures.- This paragraph shall contain any special procedures required which have not been delineated elsewhere in this section. Specific information that is appropriate for presentation shall include:

- a. Requirements, procedures, and verification which may be necessary to maintain the MODE S system input/output components, such as the data base.

Figure 9. Software Maintenance Manual

b. Requirements, procedures, and verification methods necessary to perform a library maintenance system run.

3.6 Error conditions.- A description of error conditions, not previously documented, shall also be included. This description shall include an explanation of the source of the error and recommended methods to correct it.

3.7 Listings.- Under separate cover as an appendix to this document shall be listings of coding statements in symbolic programming language or higher level language with machine language listings, if required. Annotations shall be provided to introduce components of the MODE S system. Clarifying remarks and comments appropriate to particular instructions shall be made. The listing annotations will be in accordance with MODE S system flowcharts.

PART 10

Diagnostics Manual

1. PURPOSE

The purpose of the diagnostics manual is to provide Mode S system user/maintenance personnel with the procedures and information necessary to identify a malfunction. The manual is based on the software requirements documents and characteristics of the Mode S system, and includes instructions for running the diagnostic (CPCI) and for isolating malfunctions.

2. INSTRUCTIONS FOR PREPARATION OF A DIAGNOSTIC MANUAL

Contents of the manual shall be prepared in accordance with Appendix I and arranged in accordance with the instructions, format and paragraph headings described in Figure 10. Deviations from the requirements stated herein require approval of the FAA Contracting Officer prior to implementation.

3. DETAILED INSTRUCTIONS FOR PREPARATION OF A DIAGNOSTICS MANUAL

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Figure 10. Diagnostics Manual

SECTION 1. SCOPE

State the manual's purpose, scope, organization and content.

SECTION 2. APPLICABLE DOCUMENTS

Provide by title, number and date of issue/revision the source documents for preparation of the diagnostic software and the reference documents that will be required by users.

2.1 Government documents.

2.2 Non-government documents.- (Identify the source within the contractor's organization from which the documents can be obtained.)

SECTION 3. IDENTIFICATION

Provide the following information:

- a. System name/nomenclature
- b. Diagnostic CPCI title/name and number
- c. CPCI purpose
- d. Identify the configuration of the system hardware
- e. Identify the support software required for diagnostic operation.

SECTION 4. GENERAL DESCRIPTION

Provide a general description of the diagnostic CPCI.

SECTION 5. OPERATING PROCEDURE

Provide procedures and explanations for the following CPCI operations:

- a. Diagnostic loading.
- b. Initialization.
- c. Device assignment.
- d. Diagnostic execution.
- e. Diagnostic restarts.
- f. Termination of diagnostic CPCI operation.

SECTION 6. TEST DESCRIPTION

6.1 General.- Describe the test structure of the diagnostic CPCI.

Figure 10. Diagnostics Manual

6.2 Tests.- Identify each diagnostic test and provide the following for each test:

- a. Purpose.
- b. Operator actions.
- c. Action required to omit the test.
- d. Prerequisite tests.
- e. Describe the expected output.
- f. For each possible diagnostic error (malfunction report) output, provide the following: description, output media, format, and content; and the instructions for the disposition and use of the output.

SECTION 7. OPTIONS

Describe all options of the diagnostic CPCI and provide the procedures to set, reset, and test each option.

SECTION 8. APPENDIX

Provide the following information in the appendix:

- a. Operator command summary.
- b. Summary of directives and respective functions.
- c. Description of parameters unique to the CPCI.
- d. Fault catalog listing error messages.

PART 11

Software Development Plan

1. PURPOSE

The Software Development Plan (SDP) is the document the contractor prepares to describe the specific detailed plan for the management and control of the development of all computer programs and associated documentation required by contract. The SDP is used by the FAA Contracting Officer and the Mode S Program Office to assess and approve the contractors management approach and methods for software development and is the basis for monitoring and evaluating the contractor's performance during development of the products required by contract. On approval of the SDP by the Government the contractor shall be responsible for its implementation.

2. INSTRUCTIONS FOR PREPARATION OF A SOFTWARE DEVELOPMENT PLAN

Contents of the SDP shall be prepared in accordance with Appendix I and arranged in accordance with the instructions, format and paragraph headings described in Figure 11 or in contractor format. Where contractor format is used all items required by Figure 11 shall be provided and a cross reference compliance matrix between the contractor format and the items required by Figure 11 shall be included.

3. DETAILED INSTRUCTIONS FOR PREPARATION OF A SOFTWARE DEVELOPMENT PLAN

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Figure 11. Software Development Plan

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Figure 11. Software Development Plan

SECTION 1. INTRODUCTION

Describe in this section the scope of the software development effort. Provide an overview of the contractor's management philosophy and methodology and identify any special emphasis areas/methods and the monitoring and evaluating techniques/tools to be used. Identify the computer program configuration items (CPCIs) being developed inclusive of operational, support and test CPCIs.

SECTION 2. APPLICABLE DOCUMENTS

This section shall identify all of the documents referenced in the SDP and shall identify them by title, number, revision and date of issue.

2.1 Government documents.

2.2 Non-government documents.- (Identify the source within the contractor's organization from which the documents can be obtained.)

SECTION 3. MANAGEMENT ORGANIZATION AND CONTROLS

Identify and describe in this section the software development organization. Describe, by means of diagrams and narratives, the relationship of the organization to other organizational entities in the contractor's organization and to other contractors, including the independent verification and validation contractor, subcontractors, the procuring agency, and the user agency. Identify the scope of authority and responsibility of each organizational entity and show all relevant job titles. Describe each position in detail to provide visibility and understanding of the management structure, and provide a resume of qualifications of each person assigned to the respective positions.

Describe the means and criteria for management assessment and control of the development process, including subcontracts; for example, mechanisms for initiating management actions when status dictates deviation from plan, such as resource reallocation, schedule slippage, cost increases, or performance degradation. Describe the relationships between the management controls of the SDP and other applicable management plans such as the Configuration Management Plan and the Software Quality Assurance Plan.

Describe the means and compliance mechanisms for assuring subcontractor compliance/compatibility with the software/firmware development approach, standards and procedures.

Figure 11. Software Development Plan

SECTION 4. DEVELOPMENT SCHEDULE AND MILESTONES

4.1 Task definition.- State the work tasks required to achieve the objectives of the software development effort: Identify the necessary development steps inclusive of requirements analysis, design, coding, checkout, integration, test, acceptance, and delivery for all CPCIs and major supporting computer resources and their relationship to the contractor's Work Breakdown Structure (WBS), per MIL-STD-881, including required WBS deviations. Identify tasks associated with support functions (such as documentation, configuration management, data management, management reviews, quality assurance, etc.) and their relationship to other contractual tasks; tasks involving integration and test of CPCIs (including such factors as separate test configurations, system tests, and operational tests where applicable); major development steps for all identified computer program components (CPCs) of all CPCIs, and all elements of the required computer resources which support the products.

4.2 Task schedule.- Provide a time schedule of the above work task elements, based on the contract master schedule, indicating initiation, intermediate (e.g., availability of draft and final copies of formal and informal documentation) and completion times for all CPCIs and time/performance critical CPCs including formal and informal milestones, reviews, audits, key meetings, documentation release, etc.

4.3 Activity network.- Provide an activity network (e.g., PERT) compatible with the task schedule of software development efforts, including interface activities (such as hardware development) that can impact schedule and an identification of critical path or near critical path elements. Identify those tasks and activity paths that might be most strongly influenced by changes in program requirements.

SECTION 5. RISK AREAS

Identify any functional or performance requirement of the MODE S System Specification whose attainment is considered to be a risk area. Provide a ranking of the risk areas relative to technical and cost/schedule factors and present the management/technical plan for risk avoidance/reduction and control.

5.1 Requirements.- Summarize or specifically reference documents describing the contractor's understanding and assessment of the adequacy of the software performance requirements, the definition of the hardware and software configuration items and their interfaces, and the specified computer resources. Describe the methods used to assess and control these areas.

Figure 11. Software Development Plan

5.2 Sizing and timing.- Specify required margins and budgets for computer memory, execution time, response time, central processor usage, and I/O utilization, and identify any critical timing constraints. Present the management plan used to assess and control the established budgets.

5.3 Backup alternatives.- Identify backup alternative approaches to minimize or overcome possible impacts of high risk issues.

SECTION 6. DEVELOPMENT APPROACH AND METHODOLOGY

6.1 Top level design and allocation of requirements.- Describe the approach to be used to define the top level structure and functional flow of the CPCI. Specify how top level storage allocation and computational timing and sequencing are defined and documented.

6.1.1 Algorithms.- Describe the rationale for defining CPCs and for the allocation of functional requirements to these components. Specify how top level executive control algorithms, including startup and malfunction recovery features, are defined and documented.

6.1.2 Data base.- Specify how the structure and organization of the data base are defined and documented. Identify data types and characteristics. Identify critical interface data which must be defined in detail early in the design process.

6.2 Detailed design.- Describe the approach used for detailed design of the CPCI. Specify how traceability of requirements to design is maintained. Specify how design understandability is achieved by hierarchical structures, adequate comments and definitions, cross references, etc. Describe how the work of several designers is coordinated to insure design consistency.

6.2.1 Algorithms.- Describe how CPCs are designed. Identify the modular structure used, down to the routine or procedure level. Discuss the design documentation approach, e.g., flow diagrams, structured design language or pseudocode, and/or flowcharts. Describe how design adherence to software standards and procedures (8.0) is assured.

6.2.2 Data base.- Describe how the data base is designed and documented. Show examples of descriptions of data items, arrays, blocks, records, etc. Show how the completed data base design documentation will facilitate tracing of data items from source to destination and will establish confidence in the completeness and self-consistency of the data base.

Figure 11. Software Development Plan

6.3 Coding.- Define the procedures used in coding from the software detailed design document (SDDD). Specify how traceability of detailed design elements to code will be maintained. Describe how the work of several coders is coordinated to insure program consistency. Describe how code adherence to software standards and procedures is assured.

6.4 Testing.- Discuss the philosophy and approach for software development, verification, test and integration. Show how verification and testing are coordinated with design and coding activities. Identify the extent of retesting to be done as errors are found and modifications are made to programs. Show where and to what extent independence is achieved in testing. For each level of testing, identify the facilities to be used and the organizational element responsible.

6.4.1 Unit test.- Describe the methods used by individual coders to assure the correct implementation of the design elements assigned to them and the satisfaction of all applicable software standards and procedures prior to software integration.

6.4.2 CPCI integration.- Describe the methods used to integrate the units of code into the total CPCI. Show to what extent the integration is top-down.

6.4.3 CPCI qualification.- Describe the process used to verify that the CPCI satisfies the requirements of the applicable performance and design documents.

6.4.4 System integration.- Describe the process by which compatibility of the CPCI with the operational computer and directly interfacing hardware is established. If the system includes more than one CPCI, describe the process by which the compatibility of the CPCIs with each other will be established.

6.4.5 System test.- Describe the requirements for system test and how these requirements are satisfied.

6.5 Preparation for delivery.- Describe the preparation for delivery requirements of the completed CPCIs. Packaging requirements include a description of the product packaging, preservation methods, packing, etc. involved in preparing the CPCIs for shipment and storage. Include special handling requirements or other special considerations (e.g., when shipping magnetic storage media, special EMI requirements shall be delineated). Specify in detail the identification markings on packages containing the CPCIs.

Figure 11. Software Development Plan

SECTION 7. FACILITIES AND RESOURCES

Provide an allocation for and management of facilities, laboratories, computer time, test equipments, and other relevant resources against the organizational structures, work elements, and schedules. Identify project-peculiar resources required such as special purpose hardware and computer programs, government furnished items, special data, etc. Provide a list of items which may impact resources such as high risk development items, special security requirements, subcontractor control, etc. Present the method to be used to assure compatibility of the procured systems with the intended operational physical facilities.

7.1 Contractor facilities.- Indicate the programming development and testing facility capabilities, usage for each phase of the development process, how they are manned, and what special tools or facilities are available during implementation. Also describe what methods are used (e.g., on-line terminals, etc.) and indicate the methods to be used to resolve conflicts over machine/facilities and establishment of task prioritization. Summarize or specifically reference the plan for transfer of computer resources including support software and tools to the appropriate user agency.

7.2 Government furnished equipment and services.- List all equipment, services, facilities, and programs required for this contract, which are required to be furnished by the Government. State all necessary conditions such as schedule or usage and training/maintenance support required.

7.3 Manpower and training.- Provide an allocation of manpower by grades and types against the organizational structures, work elements, and schedules. Identify risk areas such as shortages of special skills. Identify any training programs required for contractor personnel and for operational or support personnel during the deployment phase.

7.4 Models/simulations.- Describe any existing models/simulations to be used in software development and testing. Describe models/simulations which have to be developed.

7.5 Software/firmware tools.- Describe any software/firmware tools, existing or to be developed, used in software development and testing.

SECTION 8. SOFTWARE STANDARDS AND PROCEDURES

State the design and coding standards and procedures that will apply to the software development. If a Software Standards and Procedures Manual is to be developed, include a reference to that document by document number and provide

Figure 11. Software Development Plan

a list of the topics to be covered by the manual together with the schedule for its development. If an existing contractor's manual is to be used, include a copy as part of the SDP.

SECTION 9. DOCUMENTATION

Describe all documentation to be produced in the course of the software development. Relate the document types to the development schedule.

SECTION 10. CONFIGURATION MANAGEMENT (CM)

Provide a reference to the overall configuration management plan by document identification number, and address the aspects of software configuration management not addressed in the overall CM Plan including the following as applicable:

- a. organizational placement and responsibility,
- b. software configuration control board responsibilities and authority inclusive of proposed change, deviation, waiver authorization and control,
- c. computer program library responsibility and the methodology for control of development versions of CPCs and CPCIs, source and object code, test baselines, non-deliverable programs, software tools, and associated documentation.

SECTION 11. QUALITY ASSURANCE (QA)

Provide a reference to the software quality assurance plan by document identification number.

SECTION 12. SECURITY REQUIREMENTS AND CONTROLS

Identify the security requirements and controls for this software development.

Figure 11. Software Development Plan

APPENDIX I

General Instructions for Preparation of MODE S Technical Documentation

1. PURPOSE

The purpose of this appendix is to provide general instructions for the preparation of MODE S technical documentation.

2. GENERAL INSTRUCTIONS

The following sub-paragraphs shall be used as a guide for language style including abbreviations and symbols, underlining, cross-references, figures/tables, paragraph/page numbering, use of foldouts, footnotes, definitions, and references.

2.1 Page numbering.- Page numbers shall be placed at the center of the bottom of each page. Page numbering shall be numerical throughout the entire document except for the introduction, table of contents, and appendices. Page numbers for the introduction and table of contents shall be lowercase roman numerals (i.e., i, ii, iii, iv, etc.) Page numbers for appendices shall be prefixed by the appendix identifier (i.e., for Appendix A the page numbers will be A-1, A-2, A-3, etc.).

2.2 Paragraph numbering.- Each paragraph and sub-paragraph shall be numbered consecutively within each section using a period to separate the number representing each breakdown (i.e., 2, 2.1, 2.2, 2.2.1, 2.2.1.1, 2.3, etc.), and shall be limited to seven levels. Itemization within a paragraph or sub-paragraph shall be identified by lowercase letters.

2.3 Paragraph identification.- Each paragraph shall be given a subject identification. Primary paragraph identification shall be capitalized and the first letter of the first word in the sub-paragraph identification shall be capitalized, all other words shall be lower case. The identification shall be underlined starting with the paragraph number and closed by a period, followed by a hyphen.

2.4 Language style.- The paramount consideration in a technical document is its technical essence, and this should be presented in language free of vague and ambiguous terms and using the simplest words and phrases will convey the intended meaning. Inclusion of essential information shall be complete, whether by direct statements or reference to other documents. Consistency in terminology and organization of material will contribute to the clarity and usefulness of a technical document. Sentences shall be as short and concise as possible. Punctuation should aid in reading and prevent misreading.

2.4.1 Capitalization, spelling, etc.- The United States Government Printing Office Style Manual shall be used as a guide for capitalization, spelling, punctuation, syllabification, etc. Merriam-Webster's New International Dictionary will be used when the style manual does not provide the guidance needed.

2.4.2 Abbreviations.- Abbreviations employed shall be either in accordance with American National Standards Institute (ANSI) Y1.1 (1972) or be those in common usage and not subject to misinterpretation. The first time in each section of a document an abbreviation is used in text it shall be placed in parentheses following the word or term spelled out in full. This does not apply to abbreviations used for the first time in tables and equations; abbreviations so used shall be explained in a footnote.

2.4.3 Symbols.-Symbols shall not be used in the text, but may be used in equations and tables. Using a single character to form a symbol should be avoided if practicable, since in the event of an error the intended meaning would not be conveyed.

2.4.4 Commonly used words and phrasing.- The following rules shall be followed relative to certain words and phrases used in a technical document:

a. Referenced documents shall be cited thus "conforming to ..." "as specified in..." or "in accordance with..."

b. "Unless otherwise specified" shall be used to indicate an alternate course of action. The phrase shall always come at the beginning of the sentence, and if possible, at the beginning of the paragraph. This phrase shall be used only when it is possible to clarify its meaning by providing a reference to another paragraph of the document or to the contract or order or otherwise for further clarification.

c. When making reference to a requirement in a document and the requirement referenced is rather obvious or not difficult to locate, the simple phrase "as specified herein" is sufficient and should be used.

d. The phrase "...to determine compliance with..." or "...to determine conformance to..." should be used in place of "...to determine compliance to..." and the same wording shall be used throughout.

e. In stating positive limitations, the phrase shall be stated thus:
"The memory size shall be no greater than..."

2.4.5 Use of "shall," "will," "should," and "may".- Use "shall" whenever a document expresses a provision that is binding. Use "should" and "may" wherever it is necessary to express non-mandatory provisions. "Will" may be used to express a declaration of purpose on the part of the contractor/Government. It may be necessary to use "will" in cases where the simple future tense is required, i.e., power for the motor will be supplied by the aircraft.

2.5 Underlining.- Do not underline any portion of a paragraph or capitalize phrases or words for the purpose of emphasis. All of the requirements are important in obtaining the desired product or service.

2.6 Cross references.- Cross references, that is references to parts within a document, shall be held to a minimum. Cross references shall be used only to clarify the relationship of requirements within a document and to avoid inconsistencies and unnecessary repetition. When the cross reference is to a paragraph, sub-paragraph, etc., within a document, the cross reference shall be only to the specific paragraph number. The word paragraph shall not appear.

2.7 Figures.- A figure is a graphical presentation, and constitutes an integral part of a document. It shall be clearly related to, and consistent with, the text of the associated paragraph.

2.7.1 Location of figures.- Each figure shall be placed following, or within, the paragraph containing a reference to it. If figures are numerous and their location, as indicated above, would interfere with correct sequencing of paragraphs and cause difficulty in understanding or interpretation, they may be placed in numerical sequence at the end of a document before any appendix or index.

2.7.2 Preparation of figures.- All figures shall be titled, and they shall be numbered consecutively with arabic numerals in the order in which they are initially referenced in a document.

2.8 Tables.- A table is an arrangement of data in lines and columns. It shall be used when data can thus be presented more clearly than in text. Elaborate or complicated tables shall be avoided. References in the text shall sufficiently detailed to make the purpose of the table clear, and the table shall be restricted to data pertinent to the associated text.

2.8.1 Location of tables.- A table shall be placed following, or within, the paragraph containing a reference to it. If space does not permit, a table shall be placed at the beginning of the succeeding page, or if extensive, on a separate page. If tables are numerous and their location, as indicated above,

would interfere with correct sequencing of paragraphs and cause difficulty in understanding or interpretation, they may be placed in numerical sequence at the end of a document before any appendix or index.

2.8.2 Preparation of tables.- All tables shall be numbered consecutively with roman numerals in the order in which they are initially referenced in a document. The number and title shall be placed above the table. The contents of a table shall be organized and arranged to show clearly the significance and relationship of the data. Data included in the text shall not be repeated in the table. Tables shall be boxed and ruled.

2.9 Foldouts.- Foldouts shall be avoided except where required for legibility. Large tables or figures may be broken so that they may be printed on facing pages. Where foldouts are required, they should be grouped in one place, preferably at the end of a document (in the same location as figures) and suitable reference to their location shall be included in the text.

2.10 Footnotes.

2.10.1 Footnotes to text.- Footnotes to the text shall be avoided if possible. Their purpose is to convey additional information that is not properly a part of the text. A footnote to the text shall be placed at the bottom of the page containing the reference to it.

2.10.2 Footnotes to tables and figures.- Footnotes to a table or figure shall be placed below the table or figure. The footnotes may contain mandatory information that cannot be presented as data within a table. Footnotes shall be numbered separately for each table. Where numerals will lead to ambiguity (for example in connection with a chemical formula), superior letters, asterisks, and other symbols may be used.

2.11 Definitions.- The inclusion of a definition can be avoided if requirements are properly stated. When the meaning of one or more terms must be established in a document, definitions shall be placed in the text. However, it is permissible and often clearer to list definitions in a separate paragraph following the applicable documents paragraph, especially where the terms are used in many places throughout a document. When this is done, a parenthetical reference to the applicable paragraph shall follow the terms to indicate the existence of a definition.

2.12 References to other documents.- Referencing is the approved method for including requirements in a document where this eliminates the repetition of requirements and tests that are adequately set forth elsewhere. However, chain referencing shall be avoided. References shall be restricted to documents that are specifically and clearly applicable to the document, and are current and

available. Care shall be taken in writing a document to indicate in a positive manner the extent to which a referenced document is applicable. The document shall also include any special details called for by the referenced document. Reference to paragraph numbers in other documents shall not be made. The reference shall be to a title, method number, specifically identified requirement, or other definitive designation.

2.12.1 Limitation on references.- A document shall not contain anything in conflict with provisions in referenced documents unless it is desirable to make special exceptions to such provisions, in which case the specific provision to which exception is made shall be stipulated or the application of a specific portion of the referenced document shall be clearly defined. It is not intended that other documents be made a part of a document by reference unless the items, materials, tests, or other services in the referenced documents are required in the quality and detail which these documents are designed to produce. The applicability of all referenced documents listed in the applicable documents paragraph of a document shall be defined in subsequent paragraphs as appropriate. The extent of applicability of referenced documents shall also be specifically indicated. The whole of a referenced document shall not be made applicable by reference unless all of its provisions are clearly required.

2.13 Identification of technical documents.- Each document shall be numbered and dated on each page. The identification number, with the date below it shall always appear at the top of the page opposite the binding edge. The number shall not contain more than fifteen characters, excluding dashes and revision letter.

2.14 Revision symbols.- Revision letters, starting with "A" for the first revision, and assigned alphabetically for each succeeding revision, shall follow the document number. Letters I, O, Q, S and Z, can be confused with numerals and therefore shall not be used.

APPENDIX II

Glossary of Terms

Allocated configuration identification (ACI).- Current, approved performance oriented specifications governing development of CIs/CPCIs that are part of a higher level system, in which each specification (a) defines the functional characteristics that are allocated from those of the higher level system, (b) establishes the tests required to demonstrate achievement of its allocated functional characteristics, (c) delineates necessary interface requirements with other associated CIs/CPCIs, and (d) establishes design constraints, if any.

Base line.- A configuration identification document or a set of such documents formally designated and fixed at a specific time during a configuration item's (CI) or computer program configuration item's (CPCI) life cycle. Base lines, plus approved changes from those base lines, constitute the current configuration identification.

Computer program component (CPC).- A combination of one or more modules that perform a major recognizable function within a larger program. It is a functionally or logically distinct part of a CPCI distinguished, for purposes of convenience, in designing and specifying a complex CPCI as an assembly of subordinate elements. A CPC is equivalent to a subprogram.

Computer program configuration item (CPCI).- An aggregate of computer program components that satisfies an end use function and that is designated for configuration management. CPCIs vary in complexity, size, and type, from a special purpose diagnostic program to a large program within a system. CPCIs satisfy a requirement or a set of requirements of a program allocated from the functional base line of a higher level system. A CPCI is a software configuration item, just as a CI is a hardware configuration item. A CPCI can also refer to that software subset of a hardware CI.

Computer program test and evaluation.- Tests conducted prior to and in parallel with preliminary or formal qualification tests. These tests are oriented primarily to support the design and development process. These tests include, but are not limited to, normal debug techniques, code walk throughs and independent verification of algorithms. This type of testing is normally conducted by the developer in direct support of the design, code and checkout, and integration and test phases of development.

Configuration item (CI).- An aggregation of hardware/software or any of its discrete portions which satisfies an end use function and that is designated for configuration management. CIs vary in complexity, size, and type, from an electronic system to an item of support equipment. During development and initial production CIs are only those items that are referenced directly in a contract or equivalent agreement. During the operational period any reparable item designated for separate procurement is a configuration item.

Firmware.- Logic circuits in read-only memory that may be altered by the software under certain circumstances.

Formal qualification tests (FQT).- Formal tests oriented primarily towards testing of the integrated CPCI, normally using operationally configured equipment at the system test site prior to the beginning of system testing. This testing emphasizes those aspects of the CPCI requirements which cannot be verified during preliminary qualification tests. Testing requirements which cannot be verified during formal qualification tests shall be verified during system tests.

Module.- An identifiable, self-contained, compilable, independent set of computer instructions with one entry point and one exit point that fulfills a well defined function.

Preliminary qualification tests (PQT).- Formal tests oriented primarily toward compliance with verifying specification requirements for portions of the CPCI prior to formal qualification test of the CPCI. These tests are normally conducted at the contractor's design and development facilities.

Product configuration identification (PCI).- The current approved technical documentation which defines the configuration of a CI/CPCI during the production, operational, and logistics support phases of their life-cycle, which prescribes (a) all necessary physical or form, fit and function characteristics of a CI/CPCI, (b) the selected functional characteristics designated for production acceptance testing, and (c) the production acceptance tests.

Program design language (PDL).- A language for describing structured design, using english-like constructs that are easy to read and comprehend. Their use in software development is oriented to replacement of textual prose, flowcharts and expression of algorithm processes in the technical documents specifying the requirements for CPCI development and use.